NPS ARCHIVE
2000.09
ZINDER, D.

DUDLEY KNOX LIBRARY
NAVAL POSTGRADUATE SCHOOL
[illegible] 3-5101

NAVAL POSTGRADUATE SCHOOL

Monterey, California

THESIS

THE FEASIBILITY OF USING DESIGN RATIONALE TO AUGMENT THE IMPLEMENTATION STRATEGY OF MANAGED CARE

by

Daniel J. Zinder

September 2000

Thesis Advisor:	Kishore Sengupta
Associate Advisor:	Daniel R. Dolk

Approved for public release; distribution is unlimited.

REPORT DOCUMENTATION PAGE

Form Approved
OMB No. 0704-0188

Public reporting burden for this collection of information is estimated to average 1 hour per response, including the time for reviewing instruction, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. Send comments regarding this burden estimate or any other aspect of this collection of information, including suggestions for reducing this burden, to Washington headquarters Services, Directorate for Information Operations and Reports, 1215 Jefferson Davis Highway, Suite 1204, Arlington, VA 22202-4302, and to the Office of Management and Budget, Paperwork Reduction Project (0704-0188) Washington DC 20503.

1. AGENCY USE ONLY *(Leave blank)*	**2. REPORT DATE** September 2000	**3. REPORT TYPE AND DATES COVERED** Master's Thesis

4. TITLE AND SUBTITLE The Feasibility of Using Design Rationale To Augment the Implementation Strategy of Managed Care	**5. FUNDING NUMBERS**
6. AUTHOR(S) Zinder, Daniel J.	
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) Naval Postgraduate School Monterey, CA 93943-5000	**8. PERFORMING ORGANIZATION REPORT NUMBER**
9. SPONSORING / MONITORING AGENCY NAME(S) AND ADDRESS(ES)	**10. SPONSORING / MONITORING AGENCY REPORT NUMBER**

11. SUPPLEMENTARY NOTES

The views expressed in this thesis are those of the author and do not reflect the official policy or position of the Department of Defense or the U.S. Government.

12a. DISTRIBUTION / AVAILABILITY STATEMENT Approved for public release; distribution is unlimited.	**12b. DISTRIBUTION CODE**

13. ABSTRACT ***(maximum 200 words)***

The feasibility of using argumentation based design rationale capture techniques for improving the implementation strategy of managed care is investigated. The hypothesis is made that managed care is failing because it deals in "wicked" problems, which are fundamentally different than the "tame" problems encountered in traditional medicine, and that the organizational structure of managed care is not equipped to handle wicked problems. It is shown that argumentation based design rationale tools are an excellent candidate for bridging the ideals of traditional medicine to the realities of managed care for three reasons: the tools are specifically designed to explore the resolution of wicked problems, the problems encountered in managed care possess many similarities to problems that have been shown to have successful utilization of design rationale capture techniques, and the power relationships within managed care are most fitting with a collaborative implementation strategy. Recommendations for a collaborative implementation strategy of managed care, using design rationale capture tools as a mechanism of collaboration, are given.

14. SUBJECT TERMS Knowledge Management, Design Rationale, Medicine, Managed Care, Human Computer Interaction, Process Knowledge			**15. NUMBER OF PAGES** 144
			16. PRICE CODE
17. SECURITY CLASSIFICATION OF REPORT Unclassified	**18. SECURITY CLASSIFICATION OF THIS PAGE** Unclassified	**19. SECURITY CLASSIFI- CATION OF ABSTRACT** Unclassified	**20. LIMITATION OF ABSTRACT** UL

NSN 7540-01-280-5500

Standard Form 298 (Rev. 2-89)
Prescribed by ANSI Std. 239-18

THIS PAGE INTENTIONALLY LEFT BLANK

Approved for public release; distribution is unlimited

THE FEASIBILITY OF USING DESIGN RATIONALE TO AUGMENT THE IMPLEMENTATION STRATEGY OF MANAGED CARE

Daniel J. Zinder
Commander, Medical Corps, United States Navy
B.S., University of Arizona, 1984
M.D., University of Southern California School of Medicine, 1988

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN INFORMATION TECHNOLOGY MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
September 2000

PS Archive
2000.09
Zinder, D.
c.1

THIS PAGE INTENTIONALLY LEFT BLANK

DUDLEY KNOX LIBRARY
NAVAL POSTGRADUATE SCHOOL
MONTEREY CA 93943-5101

ABSTRACT

The feasibility of using argumentation based design rationale capture techniques for improving the implementation strategy of managed care is investigated. The hypothesis is made that managed care is failing because it deals in “wicked” problems, which are fundamentally different than the “tame” problems encountered in traditional medicine, and that the organizational structure of managed care is not equipped to handle wicked problems. It is shown that argumentation based design rationale tools are an excellent candidate for bridging the ideals of traditional medicine to the realities of managed care for three reasons: the tools are specifically designed to explore the resolution of wicked problems, the problems encountered in managed care possess many similarities to problems that have been shown to have successful utilization of design rationale capture techniques, and the power relationships within managed care are most fitting with a collaborative implementation strategy. Recommendations for a collaborative implementation strategy of managed care, using design rationale capture tools as a mechanism of collaboration, are given.

THIS PAGE INTENTIONALLY LEFT BLANK

TABLE OF CONTENTS

I. INTRODUCTION 1
  - A. BACKGROUND 1
  - B. MULTI-STAKEHOLDER PROBLEMS 2
  - C. SOLUTION METHODS 3
  - D. PURPOSE AND SUMMARY 6

II. MOTIVATION: PROBLEM TYPES AND ORGANIZATIONAL DESIGN 9
  - A. INTRODUCTION 9
  - B. THE NATURE OF PROBLEMS ENCOUNTERED IN MEDICINE 9
    - 1. Medicine as a Wicked Problem 9
    - 2. The Wicked Problem Defined 11
    - 3. The Resolution of Wicked Problems 13
  - C. THE ORGANIZATIONAL DESIGN OF MANAGED CARE 13
    - 1. Task 15
    - 2. People 15
      - a. The Effect of Uncertainty 15
      - b. The Development of Practice Patterns 18
      - c. The Organizational Effect of Uncertainty 19
    - 3. Information and Decision Processing 19
      - a. Professionalism 20
      - b. Perceived Quality 21
      - c. Conceptual Models of Medicine 21
    - 4. The Reward System of Medicine and Managed Care 22
      - a. Physician Satisfaction 22
      - b. Reward Model 23
      - c. Rewards of Managed Care 24
    - 5. Structure 25
      - a. The Machine Bureaucracy 26
      - b. The Professional Bureacracy 27
      - c. Organizational Form Summary 27
    - 6. The Galbraith Summary 28
  - D. DISCUSSION 29
    - 1. Assumptions and Bridges 29
    - 2. The Benefit of Capturing Design Rationale 30
  - E. CONCLUSION 32

III. FUNDAMENTAL CONCEPTS OF KNOWLEDGE MANAGEMENT 35
  - A. INTRODUCTION 35
  - B. KNOWLEDGE AND KNOWLEDGE MANAGEMENT 35

C. TYPES OF KNOWLEDGE 36

D. DIMENSIONS OF KNOWLEDGE 37
  1. Usability 37
  2. Tractability 37
  3. Expressiveness 38
  4. Ontology 38

E. PROCESS KNOWLEDGE 39
  1. Definition 39
  2. Historical Description 39
  3. The Process Centric Viewpoint 40

F. CONCLUSION 40

IV. THE THEORY UNDERLYING ARGUMENTATION BASED DESIGN RATIONALE CAPTURE 43

A. INTRODUCTION 43

B. DEVELOPMENT OF DESIGN RATIONALE CAPTURE 44
  1. Perspectives on Rationale Capture Methods 44
    a. Documentation 44
    b. Communication 45
    c. Argumentation 46
  2. The Common Choice of Argumentation 47
  3. Milestones in Research 47
    a. Diagramming Arguments 47
    b. Intellectual Augmentation at the Human Computer Interface 49
    c. Solution Methods for Wicked Problems. 50
    d. Historical Summary 50

C. ARGUMENTATION CAPTURE METHODS 51
  1. Issue Based Information System- IBIS 51
  2. Design Space Analysis - QOC 52
  3. Decision Representation Language- DRL 52
  4. Psychological Design Rationale- Claims Analysis 53
  5. Comparison of QOC to gIBIS 53

D. LESSONS FROM INDUSTRY 56
  1. Benefits 56
    a. Organizational Memory and Learning 56
    b. Enhanced Discussions and Design Meetings 57
  2. Costs 58
    a. Overhead 58
    b. Reward Systems 59

E. CONCLUSIONS 59

V. IMPLEMENTING DESIGN RATIONALE CAPTURE IN MANAGED CARE 61
- A. INTRODUCTION 61
- B. ELEMENTS OF SUCCESS 62
  - 1. Industry Survey 62
    - a. A Knowledge Oriented Culture 62
    - b. Technical and Organizational Infrastructure 63
    - c. Senior Management Support 63
    - d. A Link to Economics or Industry Value 63
    - e. A Modicum of Process Orientation 63
    - f. Clarity of Vision and Language 63
    - g. Nontrivial Motivational Aids 64
    - h. Some Level of Knowledge Structure 64
    - i. Multiple Channels of Knowledge Transfer 64
  - 2. Summary 64
- C. SUGGESTED USES 65
  - 1. Problem Selection 65
  - 2. Project Selection 65
    - a. "Off the Shelf" Product Development 66
    - b. "In-House" Product Development 66
    - c. Competitively Bid Contract Development Projects 66
    - d. Customized Software Development 66
    - e. Summary 67
  - 3. Use in Managed Care 67
- D. CASE REPORT 67
  - 1. Background and Setting 67
  - 2. Meetings 69
  - 3. Structure and Administration 73
- E. CONCLUSION 74

VI. CASE ANALYSIS AND A NEW STRATEGY FOR MANAGED CARE 75
- A. INTRODUCTION 75
- B. CASE ANALYSIS 75
  - 1. Senior Leadership Support 76
    - a. Effect on the Development Effort 76
    - b. Implications for Managed Care 77
  - 2. Adequate Infrastructure 79
    - a. Effect on the Development Team 79
    - b. Implications for Managed Care 81
  - 3. Knowledge Orientation of Culture 82
    - a. Effect on the Development Team 82
    - b. Implications for Managed Care 83
  - 4. Summary of Case Analysis 84

C. IMPLEMENTATION STRATEGIES AND CURRENT STATUS OF MANAGED CARE 85
  1. Strategy Framework 86
    a. Authoritative Strategy 86
    b. Competitive Strategy 86
    c. Collaborative Strategy 87
  2. Power Distribution in Medicine 87
  3. Physician Response 88

D. PROPOSED IMPLEMENTATION PLAN 89
  1. Collaboration through Design Rationale Capture 89
  2. Justify or Comply 91
  3. Encouraged Participation 92

E. CONCLUSIONS 92

VII. SUMMARY, FUTURE RESEARCH, AND CONCLUSION 93

A. SUMMARY 93

B. FUTURE RESEARCH 96
  1. Software Tools 96
  2. Leadership Support 97
  3. Organizational and Computational Infrastructure 97
  4. Knowledge Oriented Culture 98

C. CONCLUSION 99

APPENDIX A CASE STUDY RATIONALE 101

INITIAL DISTRIBUTION LIST 119

LIST OF FIGURES

Figure 1: The Galbraith Framework of Organizational Design 14
Figure 2: Cartoon of Managed Care Politics 25
Figure 3: (A) Document-centric System, (B) Process-centric System 41
Figure 4: An Example of the Toulmin Diagramming Technique 48
Figure 5: A Sample IBIS Representation 55
Figure 6: A Sample QOC Representation 56
Figure 7: Clinical Pathway Design Team Membership 69
Figure 8: Clinical Pathway Design Team Ground Rules 70
Figure 9: Clinical Pathway Design Team Opportunity Statement 72
Figure 10: A sample rationale diagram from the software used in the case study 102
Figure 11: Criteria Associated with Sample Diagram in Figure 10 102
Figure 12: Complete Case Study Diagram 103
Figure 13: Segmented Diagram from Case Study 103
Figure 14: Rationale Diagram Section A 105
Figure 15: Rationale Diagram Section B 108
Figure 16: Rationale Diagram Section C 109
Figure 17: Rationale Diagram Section D 111
Figure 18: Rationale Diagram Section E 113
Figure 19: Rationale Diagram Section F 115

THIS PAGE INTENTIONALLY LEFT BLANK

LIST OF TABLES

Table 1: A Comparison of Tame and Wicked Problem Characteristics 12
Table 2: A Comparison of Professional and Machine Bureaucracies............................... 29
Table 3: A Comparison of IBIS and QOC Nodes.. 54
Table 4: Rationale Table for Stroke Scale Decision 112

THIS PAGE INTENTIONALLY LEFT BLANK

ACKNOWLEDGEMENT

I wish to thank Professor Kishore Sengupta for his insight, patience, and humor. Specifically, I wish to acknowledge his uncanny ability to hear, process, and organize my frequent verbal streams of consciousness during the development of this thesis. I also wish to thank Professors Erik Jansen and Nancy Roberts for introducing me to ideas that I would never have previously considered, and Professor Daniel Dolk for his cooperation, feedback, and general love of the blues.

THIS PAGE INTENTIONALLY LEFT BLANK

I. INTRODUCTION

A. BACKGROUND

Managed care is failing. Actions in Congress[1] and cases in the Supreme Court[2] are evidence of the public's frustration with the current state of organized healthcare. This thesis hypothesizes that the frustration stems from conflict between the type of problems encountered in managed care and the organizational framework created to deal with those problems. The problems encountered in managed care are fundamentally different from those encountered in traditional medicine. The different types of problems require different organizational designs to be effectively solved. However, the organizational design of traditional medicine is built around a well-entrenched environment. Simply forcing the organizational design of managed care onto the environment of traditional medicine creates an organizational misfit that leads to conflict, frustration, and ultimately, system failure.

This thesis is based on the assumption that American society desires the care provided by traditional medicine at the prices of managed care medicine. It explores the feasibility of using knowledge management to improve the fit of managed care to the needs and desires of the public in the environment of traditional medicine. A new implementation strategy for managed care is offered using design rationale capture mechanisms as a tool for enhancing collaboration between physicians and managed care organizations. The goals of managed care are bridged to the social strengths of traditional medicine through this implementation. The goal is to use knowledge management and information technology to augment the ability of managed care to solve its problems in a manner that is minimally conflicting with the environment of traditional medicine.

---

[1] United States Senate Bill S.240. 106th Congress. Patients' Bill of Rights Act of 1999.

[2] United States Supreme Court Case 98-1949 . Pegram, Lori, et al. v. Herdrich, Cynthia. "Patient rights to sue HMO."

B. MULTI-STAKEHOLDER PROBLEMS

In traditional medicine, a patient consults a physician for medical advice. The medical problem is determined through an interview and examination, and a treatment plan is worked out that fits the patient's physical as well as psychosocial needs. Treatment is highly individualized to each particular patient and based on the physician's clinical judgment.

When managed care is introduced, new stakeholders become involved in the decision process, namely business managers and shareholders. The patient still interacts with the physician but the physician's decision process is influenced through practice guidelines, critical pathways, utilization review, capitation and/or other mechanisms. When solving any problem, each stakeholder has a different utility function for the possible solution options. In medicine, these differences in utility functions can result in any particular patient not receiving optimum care for his or her situation. An extreme example is given to illustrate this point.

Certain cases of squamous cell carcinoma of the larynx may be equally cured with radiation therapy or laryngectomy. Given the option, two patients with this same disease may choose different treatments. A priest, whose main concern is the ability to say mass, would likely opt for voice sparing radiation therapy. A farmer, who would lose her crop and family fortune if she took the time off necessary for radiation treatments, would likely choose the time sparing laryngectomy.

In each case, the problem is framed from the patient's perspective. Each patient receives the optimal treatment for the specific psychosocial reference he or she has to the disease process. However, managed care views medical problems across a population. When viewed at the population level, since medical outcome is equal for both treatments, a decision could be made to only offer the lower cost option to patients. In this case, one of the two patients would not be optimally treated from his or her perspective, even though the organization may see two cured patients and a lower bottom line.

The difference between the two models of medicine is in the level of evaluation. Traditional medicine deals at the level of the individual patient while managed care deals at the level of the population. The type of problem encountered at the population level is fundamentally different than the problem at the individual level. At the population level, the number of stakeholders is increased and therefore the number of objectives is increased. Simply defining the problem becomes the problem in managed care.

This type of problem is known as a "wicked" problem.[3] Wicked problems are ill defined, have confusing background and supporting information, multiple stakeholders with conflicting values, and result in long lasting, poorly understood consequences. The agreed upon definition of any particular wicked problem is dependent on who is framing the problem. That definition, however, leads to a solution that has everlasting consequences on the affected population, so care must be taken.

C. SOLUTION METHODS

Solutions to complex problems with multiple stakeholders often require collaboration.[3,4,5,6] (The word "collaboration" is used in the general sense to include negotiation, mediation, and simply cooperating toward a common goal depending on the level of conflict between parties.) There has been a marked increase in the number of problems of this type around the world as the global economy has become more interactive.[4,5,7] Increased interaction leads to an increased number of stakeholders, each with their own utility functions and personal agendas. An organization dealing with this type of problem could benefit from an organizational design that facilitates collaboration. Without such a mechanism, problem solving may be hindered. In terms of organizational theory, a design that lacks a necessary process has an organizational misfit to its environment. The example of reward systems is used to illustrate this idea.

---

[3] Rittel HWJ, Webber MM, Dilemmas in a General Theory of Planning, *Policy Sciences,* v.4, pp. 155-169, 1973.

[4] Gray B, *Collaborating- Finding Common Ground for Multiparty Problems,* pp 1-25, Jossey-Bass, Inc., 1989.

[5] Luke JS, *Managing Interconnectedness: The New Challenge for Public Administration,* in Public Management in an Interconnected World-Essays in the Minnowbrook Tradition, eds. Bailey MT, Mayer RT, Greenwood Press, 1992.

[6] Roberts NC, *Coping with Wicked Problems,* in Learning From International Public Management Reform (in press), Elsevier Press, 2000.

Kerr's classic essay, "On the Folly of Rewarding 'A' while Hoping for 'B'" addresses the common misfit of reward systems in various environments of American society.[8] He provides several examples of this problem. The example referencing medicine involves physician rewards. The public generally wants to be healthy but physicians are rewarded for diagnosing patients ill. Our society puts more negative emphasis on diagnosing a sick person healthy than a healthy person sick. Patients define themselves as sick and go to the doctor to be returned to their normal state. If they are actually healthy but diagnosed sick, the physician is considered to be providing sound, conservative, clinical medicine, but when a sick person is diagnosed healthy, the physician is chastised with lawsuits, labels ("bad doctor"), and embarrassment. Part of the medical reward system comes from potential results of misdiagnosis but the overwhelming result is over diagnosis and treatment. Reward systems are just one aspect of organizational design but emphasize the need to assess the fitness of organizational design to the environment when considering solutions to enterprise level problems.

If collaboration is going to be used to solve multi-stakeholder problems then some mechanism for that collaboration must be incorporated into the organizational design. The ultimate organizational misfit would be to have a critical method available for

---

[7] Hardy C, Phillips N, Strategies of Engagement: Lessons from the Critical Examination of Collaboration and Conflict in an Interorganizational Domain, *Organization Science,* v. 9, pp. 217-230, April 1998.
[8] Kerr S, On the Folly of Rewarding A, While Hoping for B, *Academy of Management Journal*, v.18, pp. 769-783, 1975.

solving fundamental organizational problems but have no possible way to implement it. This thesis asserts that managed care is close to this position in its organizational design.

Managed care facilitates collaboration by problem solving through multidisciplinary teams. Critical pathways are a prototypical example and their frequent failure is an indication that the method does not work. Successes generally involve only physician champions with little widespread use, or involve only non-physician components of care.[9,10,11] The reason this method fails is because it is not truly collaboration. It is multidisciplinary but only taps the expertise of the select few on the design committees. The majority of physicians and other stakeholders are only recipients of the committee's work, not active participants in the process.

One method of involving more participants is to provide the recipients of the various policies with the rationale behind their design: why various choices were made in creating the policy, what alternatives were considered, and why those alternatives were rejected. The rationale allows others not directly involved with development to understand the decision making process and suggest alternatives not previously considered or offer insights not available to the original team. It also provides an answer to the common question, "What were they thinking when they came up with this?" Eddy has advocated this idea in medicine for many years. He emphatically states, "Any policy maker unable to supply that information should not be making policies."[12]

Attempts have been made to record the design process for many years through lessons learned, after action reports, and other mechanisms. However, each has

---

[9] Jaggers LD, The Differentiation of Critical Pathways from Other Healthcare Management Tools, *American Journal of Health-Systems Pharmacists,* v.53, pp.311-313, 1996.

[10] Pearson SD, Goulart-Fisher D, Lee TH, Critical Pathways as a Strategy for Improving Care: Problems and Potential, *Annals of Internal Medicine*, v.123, pp.941-948, 1995.

[11] Horne M, Involving Physicians in Clinical Pathways: An Example for Perioperative Knee Arthroplasty, *Journal on Quality Improvement,* v.22, pp.115-124, 1996.

[12] Eddy DM, *Variations in Physician Practice: The Role of Uncertainty*, in Professional Judgement: A Reader in Clinical Decision Making, eds: Dowie J, Elstein A, Cambridge University Press. 1988.

significant limitations in usefulness, either from the standpoint of storage and retrieval or simply ease of use. Software tools now exist to aid in this endeavor. The tools use argumentation diagrams to help capture the rationale. This thesis uses one of these tools that is commercially available to capture the rationale behind the development of a critical pathway.

D. PURPOSE AND SUMMARY

The purpose of this thesis is to investigate the feasibility of using argumentation based design rationale to change the strategy of managed care implementation such that a collaborative, variable sum solution can be achieved. The goal is to achieve a solution that works and allows an improved fit of managed care to the environment of traditional medicine. The theoretic basis stems from an analysis of the problems encountered in, and the organizational design of, managed care. The analysis demonstrates a potential bridge between managed care and traditional medicine that may be created using knowledge management tools.

A commercial, off the shelf, software product is used to capture design rationale during a medical critical pathway development. The technique has been used in industry for software development and other engineering design processes but never in medicine. Lessons from those efforts are incorporated into this work. A case study is used to demonstrate practical aspects of the theoretic problems predicted by the organizational misfit. Design rationale are captured during the case study and the results are presented to show the value of the process knowledge and how it can be used in modifying the strategy of managed care. A strategy is built for an improved model of managed care using a recently published framework for coping with wicked problems.

The thesis is organized as follows: This chapter provides a brief overview of the overall content. Chapter II details the motivation of the thesis in terms of problem types and the organizational design that is in place to accommodate the problem types. The

Galbraith framework of organizational design is used to analyze the design of managed care and traditional medicine. Chapter III provides some fundamental background information on knowledge management, and Chapter IV examines the theoretical basis of design rational capture. Chapter V examines real world knowledge management and design rationale projects to recommend marketing strategies for implementing design rationale capture techniques in the managed care environment. A case study is also presented involving a critical pathway development at a small community hospital. Chapter VI analyzes the case study as a knowledge project. The current strategy used to implement managed care principles are investigated and a new strategy utilizing design rationale capture tools is offered. Finally, Chapter VII summarizes the work of this thesis and recommendations for future research are provided. The captured design rationale from the case study are shown in Appendix A.

THIS PAGE INTENTIONALLY LEFT BLANK

II. MOTIVATION: PROBLEM TYPES AND ORGANIZATIONAL DESIGN

A. INTRODUCTION

The problems encountered in managed care medicine are fundamentally different than those encountered in traditional, individual patient care. The organizational design of the medical industry, however, developed around the problems of individual patient care. The changes made in parts of the organization to accommodate the new problem types create conflict within the system. More technically, the imposed organizational design is a poor fit to the environment of traditional medicine. That misfit is the basis of frustration and dissatisfaction with managed care. This chapter discusses the problems and the organizational design of medicine. It is divided into two main sections. The first section explores the nature of problems encountered in medicine and the second explores the organizational design of medicine using the Galbraith framework of organizational design.

B. THE NATURE OF PROBLEMS ENCOUNTERED IN MEDICINE

Managing the healthcare of an entire population is a different problem than managing the healthcare of an individual patient. Health management decisions at the population level fall into a class of problems known as "wicked" problems. This section provides a medical example to demonstrate the practical difference in problem types and then explains the nature of wicked problems.

1. Medicine as a Wicked Problem

Consider a simple case of chronic tonsillitis. Sooner or later, a treatment decision for or against tonsillectomy is required. Tonsillectomy is usually an elective surgery, meaning it is purely a patient choice, once the clinical indications have been met. In most cases, there is no lethal harm in leaving the tonsils in place. The patient's decision to remove the tonsils is often based on morbidity or interference with daily routines or life patterns. If two patients are presented with the same information about treatment options, risks, complications, and expected outcomes, one may choose tonsillectomy while the other may choose a non-surgical option. Each would choose whichever option is optimal for their particular circumstance.

If treatment decisions are made at the population level then the choices offered a patient might change. The options presented to the patient could be less inclusive, causing one of the two patients to not receive optimal treatment in their view. For example, two well-known indications for tonsillectomy are repeated streptococcal infections and missing 20 days of school or work per year due to repeated tonsillitis. An insurance carrier could evaluate these indications for tonsillectomy and decide based on some parameter to only cover the surgery when repeated streptococcal infections were documented. The options covered by insurance that are presented to the patients missing school or work would not include tonsillectomy even though that may be the optimal and indicated treatment for them. Managing health care at the population level may forgo the needs of an individual to accommodate a population specific variable. For any one individual in the population, or even for the entire population, there may always be a better solution.

The value of the solution to the problem described has some unique characteristics. From the standpoint of the streptococcal patients, the decision was good. From the standpoint of the missed school or work patients, the decision was bad. And from the standpoint of the insurance plan, the outcome was better than it was prior to the decision. At any time the insurance carrier may re-frame the problem and change their solution. For example, their reasoning may have been purely economic in that they felt the cost of missing school or work alone, without the added risk of streptococcal infections, should be borne by the patient, while the cost risk of medical complications from streptococcal infections could be mitigated by covering removal of the tonsils. After the decision, they may find that routine appointments to check the tonsils increase to the point of costing more than performing tonsillectomies on the other patients, or that the beneficiary outcry is enough to reduce the company's good will and public image such that they reinstate coverage.

The example describes a wicked problem. Wicked problems are problems with no clear definition and no clear solution. Both the problem and the solution depend on how the problem is framed, and therefore who is doing the framing. Most important is there is never a right answer. Answers to wicked problems are good or better, or simply "good enough." They result from multiple stakeholders, each with a personal utility function, trying to come up with a workable solution to a problem that will have everlasting consequences to all involved. These are not problems unique to medicine. They were originally described in relation to city planning, and they are becoming ore common as our global economy grows. Managed care problems happen to frequently fall into the category. The next section more fully defines wicked problems.

2. The Wicked Problem Defined

Rittel and Webber characterized wicked problems as a set of ill-defined problems for which the decision space was poorly understood.[3] They enumerated several salient characteristics and defined these problems in relation to tame problems. Table 1 is summarized from Rittel. It lists the characteristics of wicked problems and compares them to tame problems. As noted in the table, simply formulating a wicked problem *is* the problem.

Tame problems have a correct and verifiable answer and a finite set of possible solutions. Examples of tame problems are mathematical or science problems, or linear programming problems. Wicked problems, on the other hand, have no right answer. Their answers are characterized as "good" or "better" as opposed to "right." There are infinite solutions available for these problems and the quality of the solution is determined by how the problem is framed. Every attempt at solving a wicked problem has some everlasting consequence so trial and error is not a viable option for solving them.

Characteristic	Tame Problem	Wicked Problem
Formulation	Definitive - An exhaustive description of the problem can be made such that a solution can be formulated.	Not-Definitive - Each solution requires more information or information from a different perspective. The formulation of the problem IS the problem.
Stopping Rules	Yes - The problem solver knows when a tame problem is complete.	No - The action of solving the problem is understanding its nature. There may always be a "better" solution.
Test for correctness	Yes - Can be evaluated on how good the solution is.	No - Generates waves of consequences over an extended period of time that can never be fully understood.
Solution Type	True/False	Good/Bad/Better/Worse/Good Enough
Trial and Error	Encouraged - Multiple attempts at solutions can be tried without penalty.	Discouraged - Every solution attempt has irreversible effects on some group or person.
Exhaustible set of solutions	Yes - All solutions may be described and attempted.	No - Nor is there a well-described set of permissible operation that may be incorporated into the plan.
Unique	No - Problem classes exist with solution principles for the class.	.Yes - There are no problem "classes." Solution principles cannot be developed to fit all members of the class.
Symptom or Problem	Problem - There are natural levels of a problem.	Symptom - There is no natural level. The higher the level of a problem's formulation, the broader and more general it becomes.
Discrepancy	One causal explanation	Multiple explanations - The choice of explanation determines the nature of the problem's resolution.
Right to be wrong	Yes - To prove a hypothesis wrong is just as valuable information as proving a theory right.	No - The aim is not to find the truth but to improve some community characteristic. Wrong answers have consequences within the affected community.

Table 1: A Comparison of Tame and Wicked Problem Characteristics
(Adapted from Rittel and Webber[3])

Wicked problems are never truly solved because they are not really understood until a solution is attempted. But once an attempt is made, there are irreversible effects on those affected so the decision-makers have no right to make an error. In a similar manner, testing a hypothesis and proving it wrong does not have the same value as it does in science. There is not much benefit to proving a hypothesis wrong and wiping out an entire population of people.

3. The Resolution of Wicked Problems

As wicked problems are framed and re-framed, multiple solutions to these problems are the norm depending on the attitudes of the time and the experts involved in the process. It is not unreasonable to expect repeated attempts to be made at the same solutions over many years as the corporate memory of previous decision results are lost. The ability to capture the lessons of previous attempts at wicked problem resolution would enable future decision makers, and all those affected by the decision, to understand the considerations made in the past as well as the ideas considered for current decisions. This type of information is a form of process knowledge (further discussed in Chapter III and Chapter IV), and is specifically known as design or decision rationale. Preserving that knowledge can help stop repeated mistakes and "reinvention of the wheel." It is also offered as the tool to bridge managed care to the environment of traditional medicine.

Preserving process knowledge requires some sort of mechanism within the organization for accomplishing it. In order to establish such a mechanism in an organization, the overall organizational design must be understood. The next section examines the organizational design of medicine and seeks out a place for a mechanism for process knowledge preservation to be put into place.

C. THE ORGANIZATIONAL DESIGN OF MANAGED CARE

This section examines the organizational design of managed care and its fitness to the environment of traditional medicine. The Galbraith framework of organizational design is used as a tool for exploring that fitness.[13] The framework was developed in the 1980s as a combination of several previous theories of management. Its basic concept is that every organization has several common aspects coexisting with varying degrees of coupling. None of the aspects are purely independent, so a change in any of the aspects requires some degree of change in the others to maintain a comfortable, minimally conflicting, fit to the environment. The framework is graphically depicted in Figure 1. Example concepts of each element are listed adjacent to the respective box. Each of the five components of the Galbraith framework will be discussed in terms of traditional and managed care medicine.

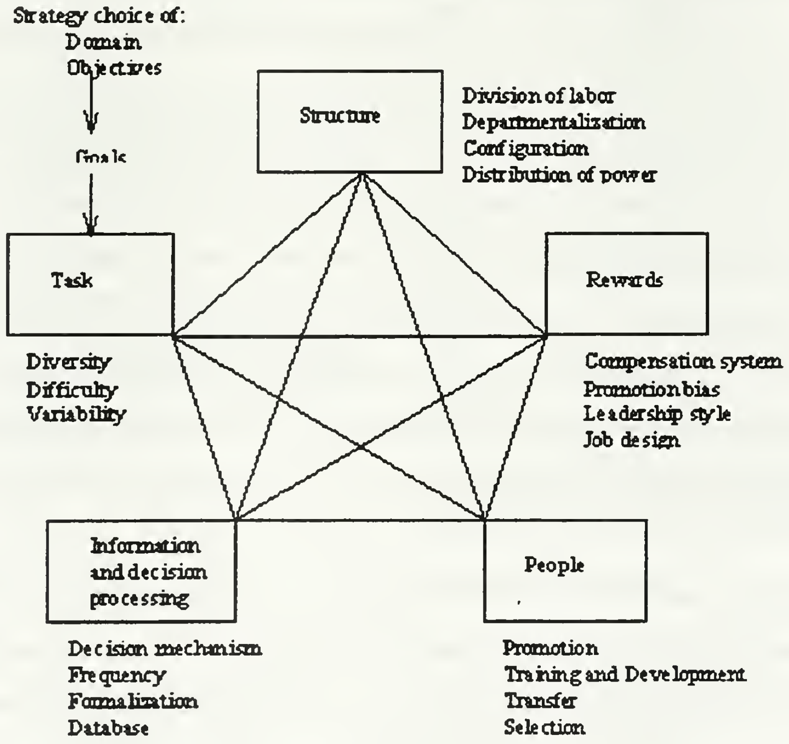


Figure 1: The Galbraith Framework of Organizational Design
(From Galbraith[13])

---

[13] Galbraith JR, *Organization Design*, pp. 11-34, Addison-Wesley, 1977.

1. Task

The goal of medicine is to do what is right for the patient. It is accomplished through the doctor patient interaction. This interaction is the *task* in Galbraith's model and is the same in both traditional medicine and managed care medicine. It is important to realize that this task is accomplished with a moral aim, not a scientific one. What is right for one patient is not right for another.

Medicine is based on three fundamental questions. What can be wrong with a patient, what can be done for a patient, and what *should* be done for the patient?[14] The first two questions can use science as a tool to achieve answers but the last question is purely moral. It deals in the virtue of practical wisdom, what Aristotle called, "...a true and reasoned state of capacity to act with regard for the things that are good and bad for man." Science is used as a tool in medicine but the ultimate goal of medicine itself is moral. The combination of science and morality is the root of conflict in managed care.

2. People

The *people* of medicine are physicians. There are many other people involved, but at the most basic level, the practice of medicine occurs at the doctor patient interaction. The other people function in a manner to carry out or support the physician's decision. Physicians are painstakingly trained throughout their education and careers to use their judgment in decision making. That judgment develops through a complex system over many years.

a. The Effect of Uncertainty

The complex process of developing clinical judgment in physicians leads to extremely strong attachments to practice patterns. Sociologic studies suggest the attachment is a result of the inherent uncertainty in scientific discovery. Science uses a probabilistic model, which, by definition, introduces uncertainty to results and decisions. Every diagnosis has a level of uncertainty of being correct and that uncertainty compounds the uncertainty of a chosen treatment succeeding. Uncertainty is an extremely powerful factor in physician decision making and clinical judgment. There is a large sociologic literature about the effect of uncertainty on physician decision-making that is briefly reviewed here.

---

[14] Pellegrino E, *The Anatomy of Clinical Judgement*, in A Philosophical Basis of Medical Practice, eds: Pellegrino ED, Thomasma DC, Oxford University Press, 1981.

Uncertainty in Medical Students was studied by Fox who found three types of uncertainty: 1) That arising from incomplete mastery of the vast and expanding range of medical knowledge and skills, 2) uncertainty due to limitations and ambiguities of that knowledge and those skills, and 3) uncertainties distinguishing between the two.[15] With respect to these uncertainties she found multiple methods of overcoming what she characterized as a sense of personal inadequacy in medical students.

Light studied the uncertainty physicians experienced in residency training when they took on actual cases rather than simply discussing them or observing them as knowledgeable outsiders. Superimposed on the three uncertainties delineated by Fox, residents, independent of specialty, were found to have uncertainties surrounding diagnosis, treatment options, patient response, and supervisor's reactions. He found that residents were forced to learn controls for the uncertainties or be paralyzed by them.[16] Significant methods of controlling uncertainties were found to be conforming to supervisory expectations rather than risk insubordination, reducing problem complexity by specialization and adoption of "schools of thought" thereby resolving uncertainty through conviction, and invoking their own clinical experiences leading to a ritual of anecdotal resolution. Bosk found residents use eight methods to manage uncertainty in diagnosis and treatment: hedging decisions, probabilistic reasoning, requests for consultation, Socratic teaching, deciding not to decide, gallows humor, hyper-realism, and focusing on uncertainty as a research problem.[17] It is interesting to note that some of these methods are personal coping strategies while others deal directly with decision making. The variety emphasizes the multifaceted nature of the process.

---

[15] Fox R. *Training for Uncertainty,* in The Student Physician: Introductory Studies in the Sociology of Medical Education, eds: Merton R, Reader GC, Kendall P, Harvard University Press, 1957.

A central part of medical training is a top-down tradition of education based on professional hierarchy. Bowers found trainees are judged by their ability to know the right answers and do the right things as deemed by their mentors and more senior trainees, a system which may be covering the fact that uncertainty exists.[18] Bosk previously gave emphasis to this idea when he discovered that normative errors arising from failure to conform to an attending physician practice patterns are often more serious than technical errors because they represent professional insubordination and possible irresponsibility.[17] This leads to dogmatic ideology such as, "Anything less than treatment X for disease Y is inexcusable" when, in fact, there may be equivocal evidence for the benefits of one treatment over the other.

Defense against and denial of uncertainty is a consistent observation made in the study of medical training. Katz emphasized, "how pervasive the disregard of uncertainty becomes whenever uncertainty ceases to be merely theoretical and impinges on... actual clinical encounters."[19] Katz concluded that practicing physicians often reluctantly admit to the three types of uncertainty described by Fox in medical students. The denial of uncertainty is evidence toward Light's thoughts that physicians must either control or be paralyzed by uncertainty.

Gerrity studied practicing physicians views on uncertainty in a survey of over 700 respondents (>60% return) and found a wide variety of techniques for dealing

---

[16] Light DW, *Uncertainty and Control in Professional Training*, Journal of Health and Social Behavior, v.20, pp.310-22, 1979.

[17] Bosk CL, *Occupational Rituals in Patient Management*, New England Journal of Medicine, v.303, pp.71-6, 1980.

[18] Bowers CA, *The Promise of Theory: Education and the Politics of Cultural Change*, Teacher College Press, 1987.

[19] Katz J, *Why Doctors Don't Disclose Uncertainty*, The Hastings Center Report v.14, pp.35-44, 1984.

with uncertainty.[20] She found a greater degree of uncertainty acknowledgement than previously reported in medical students and residents. The study allows for a more complex view of how physicians deal with uncertainty and the pervasiveness of the problem in the medical culture. Of 61 items asked on Gerrity's survey, only 23 showed consistent answers (with greater than 75% answering in agreement or disagreement.) Of those questions, many related directly to a sense of personal adequacy and failure.

The theme of personal inadequacy or failure is pervasive throughout the literature on uncertainty in medicine.[15,21,22,23,24] The importance of this fear of inadequacy and failure cannot be overemphasized. The methods individual physicians develop to work within the bounds of uncertainty are deeply rooted in their persona. The lifelong learning in medicine includes a complex process of building defense toward uncertainty. More importantly, the defense building is a means of subconsciously assuring success and adequacy in the face of uncertainty.

b. The Development of Practice Patterns

Physicians formulate practice patterns throughout their training as a series of experiential acceptance/worthiness exercises. This is done as a result of dealing with uncertainty. In terms of Maslow's hierarchy of needs, practice patterns rest within or between the levels of safety/security and love/belonging. They are deeply rooted in the physician's sense of self. Many aspects of a physician's practice may be altered or removed but the attachment to specific practice patterns will remain strong. Physicians subconsciously practice in a manner that allows them to identify themselves as successful and able to accomplish their job with sufficient adequacy. The patterns fit their persona and allow psychological reconciliation between personal uncertainties and the inherent uncertainties in medicine. It is not surprising to find that practicing physicians have a wide variety of methods for dealing with uncertainty since there is a wide variety of what an individual physician subconsciously determines to be adequate and successful. But, at the same time, it should be no surprise that requests for changes in practice patterns based on cost effectiveness and efficiency, especially from non-clinical and administrative personnel, result in negative and sometimes emotional responses.

---

[20] Gerrity MS, Earp JA, DeVellis RF, *Uncertainty and Professional Work: Perceptions of Physicians in Clinical Practice,* American Journal of Sociology, v.97, pp.1022-51, 1992.

[21] Mizrahi T, *Managing Medical Mistakes: Ideology, Insularity, and Accountability among Internists-in-Training*, Social Science and Medicine, v.19, pp.135-46, 1984.

[22] Feinstein AR, *The 'Chagrin Factor' and Qualitative Decision Analysis*, Archives of Internal Medicine, v.145, pp.1257-59, 1985.

[23] Nightingale SD, *Risk Preference and Laboratory Test Selection*, Journal of General Internal Medicine, v.2, pp.25-28, 1987.

[24] Williams G, *Regret*, Medical Decision Making, v.8, pp.310-11, 1988.

c. The Organizational Effect of Uncertainty

In terms of the Galbraith framework, conflict begins to emerge when managed care is introduced. The ultimate goal of medicine remains the moral goal of doing what is good for the patient, and the physical *task* of medicine remains the doctor patient interaction. But managed care adds new stakeholders with new goals of cost effectiveness and global efficiency. The new stakeholders bring perspectives and utility curves to medicine that may change the manner in which the *task* is accomplished. More specifically, their input may result in a different definition of what is good than the doctor and patient would define on their own.

3. Information and Decision Processing

The difficulty physicians (*people*) encounter changing deeply rooted practice patterns to match business rules leads to a social aspect of medicine, the "need" for physician dominance. In managed care, the autonomy of the physician comes into question,[25,26] and autonomy is at the heart of professionalism.

---

[25] Haug M, *A Re-examination of the Hypothesis of Physician Deprofessionalization,* The Milbank Quarterly, v.66, Suppl. 2, pp.48-56, 1988.

[26] McKinlay JB, *Towards the Proletarianization of Physicians*, International Journal of Health Services v.15, pp.161-95, 1985

a. Professionalism

Friedson describes a profession as an occupation that has achieved autonomy.[27] Autonomy is achieved by two processes- first by demonstrating the occupation does reliable and valuable work and second by having the autonomy conferred upon them by society.[27,28] The autonomy is conferred by some elite segment of society who has been convinced of the special value in the work. The autonomy also implies self-regulation as well as maintenance of values in congruence with those of society.

Prior to the introduction of managed care, and at least since the early part of the 20th century, physicians in America have met all criteria pertaining to the definition of professionals.[28] Managed care has changed the face of medicine in a variety of ways. The changes invoked by managed care to the profession of medicine are reflected in Galbraith's framework in the *information and decision processing* box. Managed care effectively limits the physician's decision space and may hinder the manner in which the *task* is accomplished.

This change is not necessarily bad. Obviously, some sort of cost control is necessary in medicine or managed care would not have appeared. However, the society that conferred autonomy on physicians must understand the ramifications of limiting that autonomy. The importance of the change is how it manifests as reward systems. Americans will eventually discover if they are hoping for a type of medical care once found prior to managed care while they reward a system that produces physicians who practice in a manner they do not desire.

---

[27] Friedson E, *The Formal Characteristics of a Profession*, in Profession of Medicne: A Study of the Sociology of Applied Knowledge, Harper and Row, 1970.
[28] Wolinsky F, *The Professional Dominance Perspective, Revisited*, The Milbank Quarterly, v.66, Suppl. 2, pp.33-47, 1988.

b. Perceived Quality

It is an important and interesting aside to realize that quality of medical care is much more complex than the outcome of disease treatment. A well-known example is patients may perceive poor quality in an outstanding clinician with poor interpersonal skills, while high quality may be perceived from a poor clinician with outstanding interpersonal skills. This relates to the aspects of the bio-psycho-social model of medicine not accounted for in the industrial measurement devices of operations research used by managed care. Managed care uses a different model of medicine that leads to further conflict. This model may be considered a bio-business model.

c. Conceptual Models of Medicine

The efficiency and cost control aspect of managed care produces a bio-business model of medicine, which has a very different focus than the bio-psycho-social model of traditional medicine. The bio-psycho-social model is focused on the individual while the bio-business model is focused on the disease outcome and the financial bottom line. The bio-business model can be drawn in the context of "boxes and arrows" with the boxes representing populations of customers and the large sweeping arrows representing customer flows through product lines. Certainly, patient treatment outcomes are important to managed care organizations but possibly from a different perspective.

The output of any business may be thought of as widgets. It is beneficial to efficiency and cost reduction to make all the widgets identically. Widgets however, do not have psycho-social components, and patients are not often happy to be considered generic, numerical, identical, customers. Physicians are trained to work at the level of the individual, while managed care stresses routinization and standardization of diagnosis and treatment processes. Although the physical outcome from standardization may be equal to less standardized methods, the overall quality of care may be diminished.

4. The Reward System of Medicine and Managed Care

Standardization also has an effect on job satisfaction. In the Galbraith framework, job satisfaction rests between *people*, *task*, and *rewards*. As noted previously the physical task of medicine does not change between traditional medicine and managed care. In the short run the people will not change either so with respect to physician satisfaction, the reward system effect of managed care must be investigated.

The long term effect of reward systems lies in recruitment and retention. The future of medicine and medical innovation as desired by society may not be what the system rewards and ultimately achieves. When the manner in which the *task* of medicine is accomplished is changed, as well as the *rewards* for accomplishing that task, the *people* who initially were attracted to medicine may not find the task as appealing as it once was.

a. Physician Satisfaction

The new model of managed care brought with it many anecdotes of decreasing physician satisfaction. It is not uncommon to hear comments such as, "Its not as fun as it once was" from the more experienced members of the profession.[29] McKinlay notes, "Medical journals regularly contain reports from older doctors that medicine today is not like 'the good old days.'"[30] The anecdotes, however, are not substantiated by studies of physician job satisfaction.

Although few studies have been done on the satisfaction of physicians in managed care environments, there is evidence that satisfaction is not extremely low. Schulz found that although primary care physicians were more satisfied than specialists, no group was markedly dissatisfied with practice in a Health Maintenance Organization. In contrast to "the good old days" they found an across the board decrease in satisfaction in fee for service practice in their study group in Wisconsin (from 1986 to 1993).[31,32] Stamps surveyed physicians in four different practice settings and found those in private group practice were most satisfied overall, but those in HMO's were most satisfied with medicine as a profession and least dissatisfied with the state's medical practice climate.[40] The details of the satisfaction studies are not as critical to this chapter as the simple fact that physician satisfaction has not plummeted in the face of managed care.

---

[29] Kleiger J, Personal Letter from the Obstetrician (delivered the author in 1962) who practiced well into his 80s, 1995.

A large part of satisfaction results from the fulfillment of expectations. The concept of ideologic relativism is important in this regard. Medical students today may not look forward to solo private practice in a completely autonomous setting as they may have 40 years ago. Their expectations are different so the fulfillment of their expectations may be less difficult. At the same time, however, as mentioned above, it is important for society to realize how this manifests as a reward system.

b. Reward Model

A common model of reward systems involves internal and external rewards.[33] Internal rewards are self-conferred while external rewards are conferred from an external source. Internal rewards can be divided into intrinsic and normative-affective rewards. Intrinsic rewards are purely individual; it is to do something because it is fun, while normative-affective rewards come about through identification with a group or an environment; it is to do something because it is the "right thing" to do. External rewards are exemplified by, "atta-boys," trophies, fines, credentialing actions, etc.

Physicians are generally motivated by a high degree of internal rewards. They most often find their work "fun" and take great satisfaction in doing "the right

---

[30] McKinlay JB, *Introduction*, The Milbank Quarterly, v.66, Suppl. 2, pp.1-9, 1988.

[31] Schulz R, Scheckler WE, Moberg P, et.al., *Physician Satisfaction in a Managed Care Environment*, The Journal of Family Practice, v.34, pp.298-304, 1992.

[32] Schulz R, Girard C, Scheckler WE, *Changing Nature of Physician Satisfaction with Health Maintenance Organization and Fee for Service Practices*, The Journal of Family Practice, v.45, pp.321-330, 1997.

thing" for a patient. There are a variety of positive external rewards in medicine as well, ranging from patient gratitude to financial compensation. Physician motivation from positive external rewards is more individualized than intrinsic motivation attributes.

c. Rewards of Managed Care

Although managed care may apply some positive external rewards to physicians such as office management in HMO's, instant patient populations, etc., it also applies significant negative external rewards. The political cartoon in Figure 2 exemplifies several aspects of this extrinsic reward system. The physician has given his autonomy to the managed care organization. (Some may consider it was taken away.) As the cartoon depicts, the "party line" from managed care organizations is that the physicians have the final say in medical matters. However, the external rewards may include decreased compensation, removal from the plan, or other less than desirable results if the final say is not in congruence with the business plan of the organization. Persistent external limitations on practice autonomy from business decisions may be enough of a negative external reward to overcome the internal rewards of medical practice in many physicians.

American society conferred autonomy upon physicians at the turn of the century because the influence of the industrial giants who "owned physicians" were found to inhibit the function of physicians.[28] Now at the end of the century physicians trained to practice with autonomy are finding themselves in conflict with a system that requires less than dominance in their position.

---

[33] Jansen E, *An Approach to Reward System,* Class Lecture (MN4125), Naval Postgraduate School, October 1999.

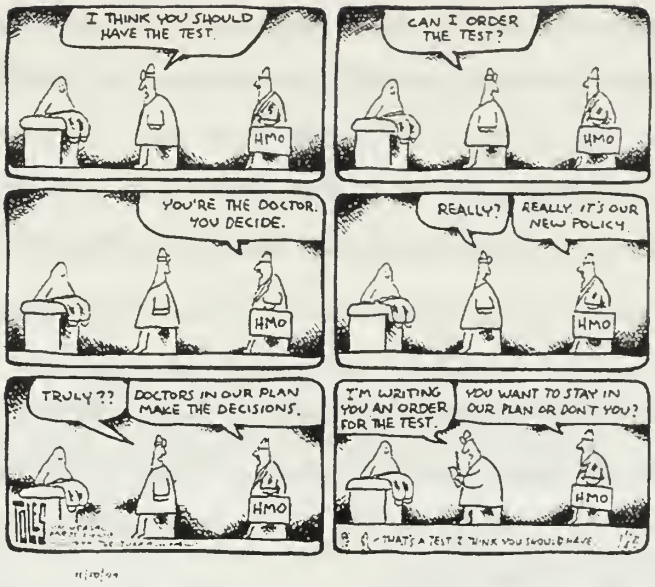

I THINK YOU SHOULD HAVE THE TEST.
HMO
CAN I ORDER THE TEST?
HMO
YOU'RE THE DOCTOR. YOU DECIDE.
HMO
REALLY?
REALLY. IT'S OUR NEW POLICY.
HMO
TRULY??
DOCTORS IN OUR PLAN MAKE THE DECISIONS.
HMO
TOLES
I'M WRITING YOU AN ORDER FOR THE TEST.
YOU WANT TO STAY IN OUR PLAN OR DON'T YOU?
HMO
THAT'S A TEST I THINK YOU SHOULD HAVE.
11/10/99

Figure 2: Cartoon of Managed Care Politics[34]

As Galbraith's model predicts, change in one aspect of an organization will cause changes in the other aspects if the organizational fit is to be maintained. The *task* in medicine is still accomplished with managed care, but the *reward system* and the *decision processes* inherent to managed care may change the manner in which the task is accomplished and eventually attract *people* that are in congruence with the organization and its characteristics, rather than the type of person society desires as a physician.

5. Structure

This section examines the final aspect of Galbraith's framework, the organizational structure. It is through the structure of the medical organization that standardization is realized. Mintzberg's model of organizational structure is used to compare this aspect in managed care and traditional medicine.[35]

---

[34] The Buffalo Daily News 10 November, 1999.

[35] Mintzberg H, *The Structuring of Organizations*, in The Strategic Process: Concepts, contexts and cases, eds: Quinn JB, Mintzberg H, James RM, Prentice Hall, 1988.

Mintzberg described six natural organizational configurations defined by their relationships between the strategic apex (upper management), middle management, and the operating core. He relates these central three layers of the organization to the technostructure and support staff, as well as the overall ideology or culture of the organization. The six configurations each have a characteristic work coordination mechanism.

Managed care most closely resembles what Mintzberg calls a "Machine Bureaucracy," while traditional medicine most closely resembles his "Professional Bureaucracy." Both use standardization as a work coordination mechanism, but standardization thorough different means.

a. The Machine Bureaucracy

Mintzberg describes the Machine Bureaucracy as follows:

> ...it requires a large technostructure to design and maintain its systems of standardization, notably those that formalize its behaviors and plan its actions. And by virtue of the organizations dependence on these systems, the technostructure gains a good deal of informal power... ...A large hierarchy of midline managers emerges to control the highly specialized work of the operating core. But that midline hierarchy is usually structured on a functional basis all the way to the top, where the real power of coordination lies.[35]

This organizational description fits the scenario of physicians asking for permission from insurance carriers to perform procedures that may or may not be on the protocols or pathways provided by the higher levels in the organization. It also describes the scenario where the clinical directors may call physicians and discuss ways to decrease variances from the instituted pathways or guidelines.

Standardization in the machine bureaucracy is accomplished through standardizing the work process. This is most often done by providing step-by-step instructions. The instructions are generally provided to the operating core by the organization's technostructure. Examples include a fast food restaurant devising a method of cooking french fries, or a toy manufacturer providing assembly instructions to the consumer.

b. The Professional Bureacracy

Mintzberg describes the Professional Bureaucracy as follows:

> ...it emerges as dramatically different from the machine bureaucracy. ...In having to rely on trained professionals to do its operating tasks, the organization surrenders a good deal of power not only to the professionals themselves but also to the associations and institutions that select and train them... power over many decision, both operating and strategic, flows all the way down... to the professionals themselves. ... There is little need for a technostructure, since the main standardization occurs as a result of training...[but] the support staff is very large..., in order to back up the high priced professionals.[35]

This organizational description fits the scenario of a highly skilled physician, dominant in the organizational hierarchy. The physician autonomously makes decisions that create work carried out by the large support staff, and then moves on to the next patient in the core function of the organization.

Standardization in the Professional Bureaucracy is based on the worker. The workers' skills are standardized as opposed to the work process itself, as in the Machine Bureaucracy. Workers are hired with requisite skills or trained by an outside source to acquire the skills, which are then applied to the work. This type of coordination is generally used when a high level of judgment is needed to perform the requisite tasks, such as those found in medical or legal practices.

c. Organizational Form Summary

Characteristics of the Machine and Professional Bureaucracies are summarized in Figure 4. While the Machine bureaucracy produces highly uniform output, it is not well suited to professional workers, such as physicians. In fact, this method of standardization creates a great deal of conflict in managed care.

Professional workers are highly trained in an abstract body of knowledge to function independently. Professional output is standardized through training, not through formalized work processes (like critical pathways). Highly formalized work processes are better suited to unskilled workers. As Mintzberg[35] notes, "...formalization and training are basically substitutes of one another. Typically the organization has to choose one or the other, not both, depending on the complexity of the work in question. ...one focuses on unskilled work while the other is oriented toward complex, professional work... ...professional tasks must be controlled by those who perform them." Mintzberg's description of organizational configurations essentially predicts the need for physician autonomy. Not surprisingly, autonomy is consistently found to be a top factor affecting physician job satisfaction.[31,36,37]

6. The Galbraith Summary

The systematic approach to organizational analysis using Galbraith's framework demonstrates several conflicts between managed care and the environment of traditional medicine. The *task* of medicine remains the doctor patient encounter but the manner in which the task is accomplished is altered by the limitations managed care places on the physicians (*people*) through the *information and decision processing* element of the organization. The changes are implemented through changes in the *structure* of the organization that change the method of work standardization. These changes manifest as negative extrinsic *rewards* to the physicians who are painstakingly trained to function autonomously using their clinical judgment.

---

[36] Stamps P, *Physicians and Organizations: An Uneasy Alliance or a Welcome Relief?*, The Journal of Family Practice, v.41, pp.27-9, 1995.

Trait	Professional Bureaucracy	Machine Bureaucracy
Coordination	Standardized Skills	Standardized Work
Structure	Decentralized bureaucracy, training (credentials), fluid administration, large support staff.	Specialized, functional large units, sharp divisions
Power	Highly decentralized (autonomous experts), "inverted pyramid", professionally controlled.	Centralized Bureaucracy, technocratic, sometimes externally controlled
Context	Complex, stable (established) services	Mature, stable industries, rationalized, repetitive work "recipes"
Types	Professional institutions, craft operations.	Mass producers, routine service, government, safety, control bueaucracies,"instruments", "closed systems"
Strengths	Dedicated (autonomy and democracy), proficient.	Efficient, reliable, precise, consistent
Problems	Irresponsibility (to clients), disloyalty (to organization), conflictive, maladaptive	Impersonal, detached, inflexible, obsession with control
Keys	Harmonizing Interfaces	Fine tuning, periodically reorienting.

Table 2: A Comparison of Professional and Machine Bureaucracies
(Adapted from Mintzberg[35])

D. DISCUSSION

1. Assumptions and Bridges

As previously noted, the changes managed care has applied to medicine, and the changes that have resulted in the manner in which the task of medicine is carried out, are not necessarily bad. If society decides these changes are good then there no further action is necessary. However, if these changes are deemed bad, then some mechanism of change must be put into place. As noted in Chapter I, there is evidence that society is not happy with the current state of organized health care. This thesis proceeds under the assumption that society desires a version of medicine that is closer to traditional medicine

---

[37] Warren MG, Weitz R, Kulis S, *Physician Satisfaction in a Changing Health Care Environment: The Impact of Challenges to Professional Autonomy, Authority, and Dominance*, Journal of Health and Social Behavior, v.39, pp.356-367, 1998.

than the more impersonal, industrial, version of medicine that managed care provides, but at the prices of managed care.

Returning to an organizational acceptance of the bio-psycho-social model of medicine and returning a large amount of autonomy to physicians are two mechanisms of effecting change in the desired direction. A physician should be able to consider the individual in conjunction with the organization rather than in conflict with the organization. The physician should also be able to practice in a manner suitable to his or her own insecurities and needs. The new system cannot, however, be a direct return to the pure professional bureaucracy that has already failed financially.

If it is assumed that society desires medicine to be practiced in the manner of traditional medicine then the *people* of medicine must be held constant in the Galbraith framework. Changes to other attributes of the framework must be made to maintain the fiscal constraint of managed care while providing the *rewards* and *decision processing* that the physicians desire. The structure of the organization is the only component left to target for change. Interestingly it is also the component in greatest conflict. As Mintzberg noted, the standardization methods of the Machine and Professional Bureaucracies are substitutes. They are in direct conflict with each other.

The goal of this thesis is to improve the fit of managed care to the environment of traditional medicine by bridging the work standardization of the Machine Bureaucracy to the skills standardization of the Professional Bureaucracy. The knowledge management method of argumentation based design rationale capture is offered as a tool to form this bridge.

2. The Benefit of Capturing Design Rationale

Capturing design rationale offers a method of returning autonomy to physicians. Traditionally, practice policies such as pathways and guidelines are provided to physicians without any justification or explanation of what went into their development. In this manner the majority of physicians are excluded from the development process. Their clinical judgment is ignored and there is little if any mechanism available to inject it. Argumentation based design rationale capture is a method of retaining the thought process of development and allowing an incremental, collaborative effort over time. All interested physicians can review the thoughts and ideas that went into a practice policy development and see if all the options they would consider were included in the deliberations. They can also justify changes to the policies based on new or unconsidered data or simply change their own practice patterns if they cannot justify change to the policy.

A second benefit of capturing design rationale is the development of more complete policies and guidelines. Without capturing the thoughts that went into a practice policy development, new committees are likely to repeat literature searches and repeat development efforts. By maintaining the thoughts and efforts of previous teams, incremental changes can be made to existing policies rather than starting from scratch every time a policy is revised. In this manner the policies can be more encompassing.

A similar effect is seen routinely in computer programming; as languages are developed, more complex programs result. For example, in object oriented programming, if a mathematical function is needed in a program then a module probably exists to do that. The programmer knows the module works and does not have to spend time coding the calculation; he or she can simply "plug in" the module and concentrate on more complex functionality. In the same regard, practice policy design committees can concentrate on new aspects of policies or modify existing portions without worrying about redesigning an entire policy from scratch.

The result of this incremental and collaborative approach to design over time could eventually result in dynamic policies. These would be pathways or guidelines that consider the psychosocial aspect of a patient's disease with multiple branches depending on the patient's situation. Although not a rigid standardization, they would provide for a general trend of practice patterns that would be markedly better than the uncontrolled patterns of traditional medicine.

Computerized knowledge tools exist to capture design rationale and maintain the knowledge in a usable format. The potential benefit of such a tool to organizational learning and "corporate memory" is tremendous. The opportunity to involve all physicians in incremental pathway development is a method of returning autonomy to the physicians. With the supporting data, the physicians have the opportunity to gain comfort with the policies and the considerations that led to them. They are also given ample opportunity to change the pathways based on new or unexplored information. Eventually the policies would be able to recognize the psychosocial aspects of individual patient care. Tool such as these can act as the desired bridge between managed care and the environment of traditional medicine that return an amount of autonomy to physicians and recognize a higher degree of individualized patient care than current managed care policies.

E. CONCLUSION

Managed care medicine is in tremendous conflict with traditional medicine when viewed from the organizational perspective. The basis of the conflict is in the level of organizational measurement. Managed care views medicine from the level of the population, while traditional medicine views it from the level of the patient. From the differing views emerged two drastically different organizational structures: the machine bureaucracy of managed care, and the professional bureaucracy of traditional medicine. The two organizational structures effect very different reward systems, and information decision processes, which together change the manner in which the task of medical care is accomplished. Ultimately, the people of medicine, the physicians, will change to fit the other aspects of the system that have changed.

The assumption is made that society desires to maintain the ideals and physicians of traditional medicine, while reaping the financial benefits of managed care. One method of achieving this mix is to bridge the two organizational structures by returning autonomy to the physician and allowing more liberal application of the psycho-social aspects of medicine to patient care. A mechanism that may act as that bridge is the capture of design rationale in policy, pathway, and guideline development.

THIS PAGE INTENTIONALLY LEFT BLANK

III. FUNDAMENTAL CONCEPTS OF KNOWLEDGE MANAGEMENT

A. INTRODUCTION

Design rationale capture introduced in Chapter II is a form of knowledge management. Knowledge management is becoming increasingly important in corporate America. In 1996 over 40% of Fortune 1000 companies had established a Chief Knowledge Officer executive position.[38] Despite all the efforts, there remains great confusion about how to manage knowledge. This confusion stems from the difficulty in simply defining knowledge. This chapter provides background and theoretical information about knowledge and knowledge management, including a definition of knowledge and its dimensions, as well as further delineation of the type of knowledge used in this thesis, "process knowledge."

B. KNOWLEDGE AND KNOWLEDGE MANAGEMENT

Knowledge management is in its infancy as a field of study. Its importance lies mainly in the area of organizational memory and learning. If experiential knowledge gained within an organization can be captured and transferred to new or inexperienced employees, then the efficiency of the organization is likely to rise dramatically.

The term, "knowledge management" has become a buzzword in corporate America but the definition and understanding of just what knowledge management consists of remains elusive. Simply defining knowledge itself is a difficult problem. Once defined, categorized, and dimensioned, however, tools can be developed to truly manage knowledge. The best understanding of knowledge may come through insight. In that respect, two definitions that have gained popularity in academia are presented below. They provide perspectives that may give insight to the concept of knowledge.

---

[38] Roberts B, *Internet as Knowledge Manager*, Web Week, pp. 30, 9 September, 1996.

> Knowledge consists of truths, beliefs, perspectives and concepts, judgments and expectations, methodologies and know-how. Knowledge is accumulated, organized and integrated and held over longer periods to be available to be applied to handle specific situations and problems.[39]

> Knowledge is a fluid mix of framed experience, values, contextual information, and expert insight that provides a framework for evaluating and incorporating new experiences and information. It originates and is applied in the minds of knowers. In organizations, it often becomes embedded not only in documents or repositories but also in organizational routines, processes, practices, and norms.[40]

C. TYPES OF KNOWLEDGE

Knowledge can be categorized as artifact knowledge or process knowledge.[41,42] The outcome of a design or development process is an artifact. The design itself is the body of knowledge contained in the artifact. Parallel to that artifact is a body of knowledge that explains why the design looks the way it does. That body of knowledge contains the thoughts, ideas, and considerations at each point along the design path. The knowledge is separate from the design artifact and is known as "process knowledge." Traditionally, organizations capture artifact knowledge and maintain it for future use, but often lose the associated process knowledge.

Capturing process knowledge in addition to the design artifact, allows a richer understanding of the design artifact. It allows retrospective analysis of why the designed artifact appears as it does and why various alternatives were considered and rejected. Examining process knowledge during the design phase enhances design space exploration and may facilitate the design process. These ideas are more fully explored in Chapter IV.

---

[39] Wiig K,. *Knowledge Management, The Central Management Focus for Intelligent-Acting Organizations*, v2, Schema Press, 1993.

[40] Davenport TH, Prusak L, *Working Knowledge: How Organizations Manage What They Know*, pp. 5, Harvard Business School Press, 1998.

[41] Floyd C, Mehl W-M, Reisin F-M, et.al., *Out of Scandanavia: Alternative Approaches to Software Design and System Development*, Human-Computer Interaction, v.4, pp.253-350, 1989.

D. DIMENSIONS OF KNOWLEDGE

Managing knowledge is similar in some ways to managing any other item. Some form of measurement or comparison is needed from which to base management decisions. In that regard, knowledge must have dimensions to measure and compare. Three dimensions of knowledge that can be used for these purposes are usability, tractability, and expressiveness. These dimensions relate directly to the three elements of a knowledge system: the user, the capture or representation tool, and the knowledge domain.[43]

1. Usability

Usability describes the ease in which knowledge can be utilized. For instance, if the corporate memory of a particular event is recorded through interviews and transcribed into a massive volume of text, then any particular user may not find the knowledge usable since the entire volume must be scanned to find a desired snippet. However, if the volume is heavily indexed and categorized, then it may become more usable.

2. Tractability

Tractability describes the ability to perform computation on the knowledge. An example of a high degree of tractability would be for a computer to be able to learn from knowledge and predict events or make inferences based on previous experience. Lower levels of tractability may include keyword searches or simple counts of predetermined parameters.

---

[42] Moran TP, Carroll JM, *Overview of Design Rationale,* in Design Rationale Concepts, Techniques, and Use, eds: Moran TP, Carroll JM, pp. 1-10, Lawrence Earlbaum Associates, 1996.

[43] Lee J, Lai KY, *What's in Design Rationale?,* in Design Rationale Concepts, Techniques, and Use, eds: Moran TP, Carroll JM, pp. 21-51, Lawrence Earlbaum Associates, 1996.

3. Expressiveness

Expressiveness quantifies what is conveyed in a representation of knowledge. Expressiveness has been described in terms of richness or "thickness."[44] It is the ability of a representation to capture the cues that mediate everyday conversations among people. For example, a gesture captured in videotape of a conversation is a thick representation of knowledge. Although the clip may be only a few seconds long, there is a tremendous amount of context specific knowledge in that behavior. Indexing that knowledge is a very difficult task using present day methods. Simply listing it as a particular gesture will cause the clip to be retrieved inappropriately many times. But to index all the aspects of that short clip would be labor intensive and very costly. Technology is not yet available to index and retrieve thick knowledge in an efficient manner. Currently, all retrieval techniques must be simplified by a thin, often text based, indexing scheme.

4. Ontology

Although not a dimension of knowledge, ontology is an important aspect of knowledge management. Ontology is a metaphysical term describing the study of the nature of existence or being. In knowledge management terms, ontology can be thought of as an organizational plan established for the storage and indexing of knowledge. It provides a method for retaining and retrieving knowledge from a particular epistemological view. The chosen ontology may affect both usability and tractability depending on the technology used for knowledge management. For example, various forms of technology allow for knowledge base searches, but the knowledge must be captured and indexed in a manner that will result in appropriate search results. If an organizational specific ontology is established early, then the necessary librarianship can be in place during knowledge capture, which will improve the quality of search results. If users understand the ontology, then they are more likely to have successful searches and more likely to find the tools usable. Designing or choosing an appropriate ontology is a management responsibility that is critical to the successful implementation of knowledge management.

---

[44] Anderson RJ, Heath CC, Luff P, Moran TP, *The Social and the Cognitive in Human-Computer Interaction*, Int. J. Man-Machine Studies, v.38, pp. 999-1016, 1993.

E. PROCESS KNOWLEDGE

1. Definition

Process knowledge includes all that is learned and known about the creation of an artifact. It includes the options considered in a decision, the reasoning behind selection or rejection of those options, as well as outcomes, difficulties encountered, etc. Process knowledge is crucial to organizational memory. Traditionally, most of the knowledge gained through a process is maintained in the memory of the participants. That knowledge is essentially lost through the frailty of human memory, worker attrition, and the inability to gather, or even identify, process participants several months to years after the events.

Organizations have frequently tried to capture process knowledge in the form of "lessons learned" or "after action reports." These reports are often filed away, hidden from the core functional components of the organization. Retrieval and future utilization are difficult at best, and often dependent upon a senior member remembering that they exist. When they are retrieved, substantial effort is often required to sort through to find the valuable portions that apply to a new project.

2. Historical Description

Brown put forth the idea of process knowledge, as opposed to product knowledge, in a 1985 paper describing electronic learning.[45] He specifically viewed the computer as a communication tool rather than the more conventional computational tool. Describing process capture, Brown astutely noted the following:

---

[45] Brown JS, *Process vs. Product: A Perspective on Tools for Communal and Informal Electronic Learning*, J. Educational Computing Research, v.1, pp.179-201, 1985.

> By making explicitly available to the user the series of steps and missteps that leads to the creation of a particular object or result, we create a basis on which to build extraordinarily powerful editing, merging, undoing, and transforming tools.....It provides a way to greatly enhance the communication to others of what one has done by enabling the user to communicate aspects of how it was done....Both the 'bandwidth of communication' and the potential depth of understanding are expanded when one can transmit not just the finished piece of work, but also information about the process that led to its final form.[45]

3. The Process Centric Viewpoint

Conklin describes a necessary culture change to implement knowledge management.[46] He describes the culture in terms of its centricity. Traditionally, organizations function in a document-centric manner. Documents are created or modified and then passed between users for consideration. They are the focus of work output. The processes that occur between document handoffs are essentially lost.

In a process-centric system the process is available for collaboration and future use, while documents are peripheral elements, available as needed. The focus of the organization is the process itself. The processes are captured for future utilization. Documents are available but are not the main thrust of an effort.

The technology exists to capture process knowledge but it comes at a cost of overhead. The amount of overhead depends on the thickness of the process information desired. The cultural change required is the acceptance that rationale capture is valuable and worth the added overhead

F. CONCLUSION

This chapter provides a definition of knowledge and background information about knowledge management. The dimensions of knowledge can be used in metrics for assessing knowledge, knowledge tools and knowledge parameters. The cultural change necessary to utilize knowledge may be the largest obstacle to knowledge management implementation and should not be underestimated. The next chapter explores the theory underlying the capture of process knowledge including the theory behind the argumentation based software tool used in this thesis.

---

[46] Conklin EJ, *Capturing Organizational Memory*, Working Paper, Group Decision Support Systems, Inc., pp.1-5, 1996.

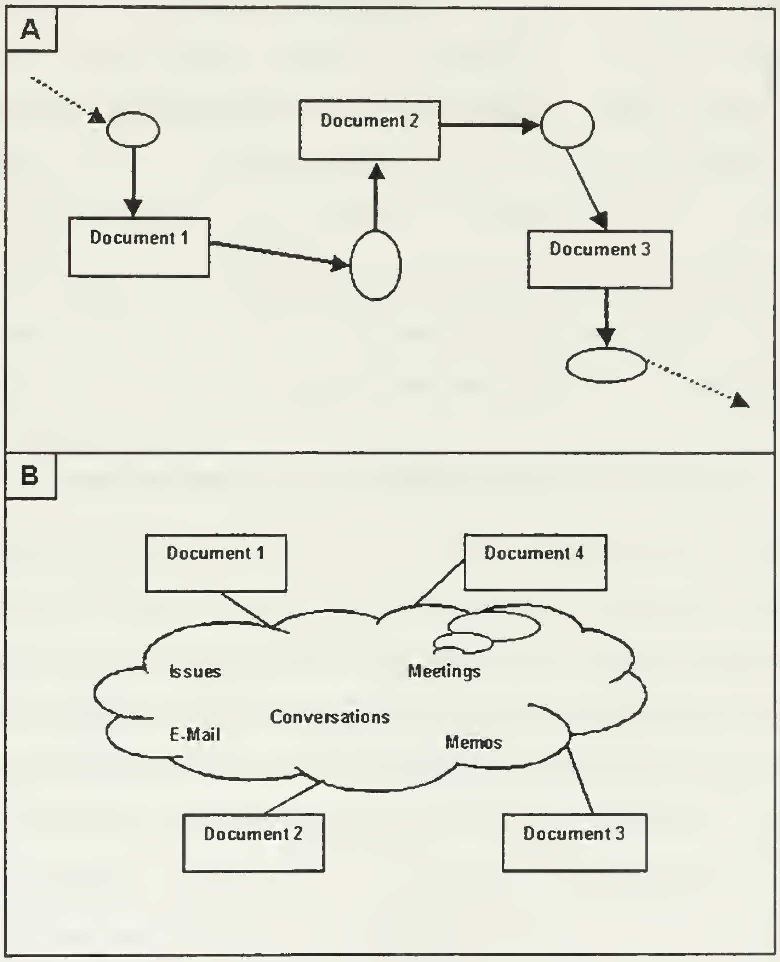


Figure 3: (A) Document-centric System, (B) Process-centric System
(Adapted from Conklin[46])

THIS PAGE INTENTIONALLY LEFT BLANK

IV. THE THEORY UNDERLYING ARGUMENTATION BASED DESIGN RATIONALE CAPTURE

A. INTRODUCTION

Process knowledge is the foundation of corporate memory and learning. Much of the "learning curve"[47] associated with manufacturing production and design processes is due to unspoken and unwritten process knowledge. The tacit nature of process knowledge combined with personnel turnover and shifting within an organization leads to corporate memory loss, and therefore productivity loss. The modern, dynamic team approach to organizational structure is effective in creating flexibility and adaptability for companies in the fast paced environment of the new economy but also increases the need to record process knowledge. There is no time to invent the wheel twice. Recording process knowledge for future use minimizes the need to do so and therefore can increase efficiency and competitiveness.

In medicine, managed care tries to develop policies such as pathways and guidelines in effort to reduce cost by standardizing care. However, the development work for these standards is fragmented and isolated. Two main problems result from the isolation. First, resultant guidelines and pathways are available for review between institutions and development teams, but the lessons learned during their development are not. Similar problems are solved repeatedly at multiple institutions. And second, the rationale behind resultant policies are not available to the physicians they affect. The result has been physicians learning the specific documenting techniques that allow them to practice in the manner they desire within the policies rather than standardizing care in the manner the policies intended. The inherent inefficiencies in the system create work duplication and wasted effort, as well as limited effectiveness in modifying physician behavior.

---

[47] Wright TP, *Factors Affecting the Cost of Airplanes,* Journal of Aeronautical Science, v.3, 1936.

The reasoning behind design decisions, effects of previous solution attempts, and the reasons for selecting or rejecting considered options are all examples of process knowledge. More specifically, these are known as design (or decision) rationale. Their effect on corporate behavior and efficiency are being recognized in industry, and the same advances in industry can be realized in managed care. Methods for capturing these rationale have been evolving for many years. This chapter reviews the development of design rationale and explores more fully the argumentation-based techniques that appear to be the most promising technique for capture. The historical development of design rationale capture is reviewed and methods of argumentation-based capture are examined.

B. DEVELOPMENT OF DESIGN RATIONALE CAPTURE

In this section, the historical development of design rationale capture is examined. First, the various perspectives on capturing rationale are discussed, and then an explanation of why argumentation is a common choice for the task is given. Finally, some milestones in past research about diagramming argumentation are discussed.

1. Perspectives on Rationale Capture Methods

Shipman describes three perspectives on rationale capture: documentation, communication, and argumentation.[48] Each is described and then evaluated in terms of the knowledge dimensions previously described: usability, tractability, and expressiveness.

a. Documentation

Documentation is the traditional means of capturing design rational. It consists of explanations in written reports. The documents are generally retrospective and capture the author's recollection of what occurred as opposed to what actually happened when it occurred. Their creation is often a collateral duty for one of the design team members and they are often generated because of contractual obligation.

---

[48] Shipman FM, McCall RJ, *Integrating Different Perspectives on Design Rationale: Supporting the Emergence of Design Rationale from Design Communication*, Artificial Intelligence in Engineering Design, Analysis, and Manufacturing (AIEDAM), v.11, pp.141-154, 1997.

The usability of documentation type rationale is dependent upon the indexing scheme used. Most often, a future designer wishing to review previous efforts must read many pages of text to find the desired information. Tractability is limited to word searches or keyword finds in sections, and expressiveness is limited by the creativity of the author.

b. Communication

Communication capture refers to the recording and storage of all material related to a project. E-mail, memos, and reports are electronically stored, meetings videotaped, conversations recorded, etc. The capture and storage of this information requires personnel to perform the recording and filing.

Usability of this type of captured knowledge is hampered by the large amount of extraneous information captured. For example, videotape of a meeting may contain a large amount of incidental conversation unrelated to the topic of interest. The extraneous information hampers retrieval of specific information.

Tractability is very difficult in this type of capture, but expressiveness is maximized. This is a classic tradeoff in knowledge representation. The thicker the representation, the more difficult it is to quantify and perform computation. Current tractability is limited to thin representations or descriptions. Annotating or indexing the thick, communication based, captured knowledge is an extremely labor intensive process. Not only do the videotapes, memos, conversations, etc. have to be analyzed and indexed in multiple ways, but the workers performing the analysis must be knowledgeable in the subject matter to provide adequate and accurate labeling. This trade off of tractability and expressiveness remains one of the greatest challenges in knowledge management.

c. *Argumentation*

Argumentation capture is done during the design process, either in real time or in near real time based on recordings of the proceedings. Issues raised, positions suggested for solution, and arguments for and against the various positions are noted. Two entities exist at design completion: the design entity, and the rationale entity. Several methods exist to capture argumentation (Section C).

The usability of argumentation techniques is method/software dependent, but generally relatively easy once the basic concepts are understood. Retrieval is extremely easy utilizing point and click technology on GUI interfaces. Capture requires a moderate degree of understanding to build the argumentation diagrams in an appropriate manner. For example, labeling an issue, "Should we play baseball?" and providing two options, "Yes" and "No," is an inappropriate use of this technique. A more expressive representation would be, "What should we do?" as an issue, and two options, "Play Baseball" and "Do Nothing." The latter representation allows criteria to be more uniformly compared between the options and it also allows for more options if desired.

Tractability of this technique is enhanced by the natural segmentation of the arguments into issues, options and criteria. Word searches can still be performed as in documentation techniques, but computation on nodes can be performed as well, such as counts of "supports" or "challenges" links. More complex numerical assessments of various options using formula based criteria are also possible to rank the options. Expressiveness is not as thick as communication based methods but can be better than documentation techniques. Although most of the nodes are expressed in a text format, the nodes can be hyper-linked to other file formats such as video, sound files, etc. The links allow the degree of expressiveness necessary for each particular node.

2. The Common Choice of Argumentation

Argumentation based techniques are a common choice for capturing rationale. They have been contemplated in decision making for thousands of years, for example, Aristotle's syllogism is an example of using argumentation for decision making. Argumentation as a form of rationale capture is a natural outgrowth of the decision or design process itself. Decisions and design processes involve trade-offs or compromise between attributes. The contemplation of alternatives compared to the chosen solution at every step requires negotiation between design team members or by a sole designer. Negotiation requires justification and justification implies argumentation. One option must be arguably better than another to make a reasoned choice for problem resolution.

3. Milestones in Research

Much of the progress made on computerized process knowledge tools is based on three main works, Toulmin's argumentation diagramming, Engelbart's emphasis on human computer interaction, and Rittel's Issue Based Information System. These foundational papers establish the value of diagramming arguments, the possibility of augmenting decision making through human computer interaction, and the need for a methodology to solve wicked problems.

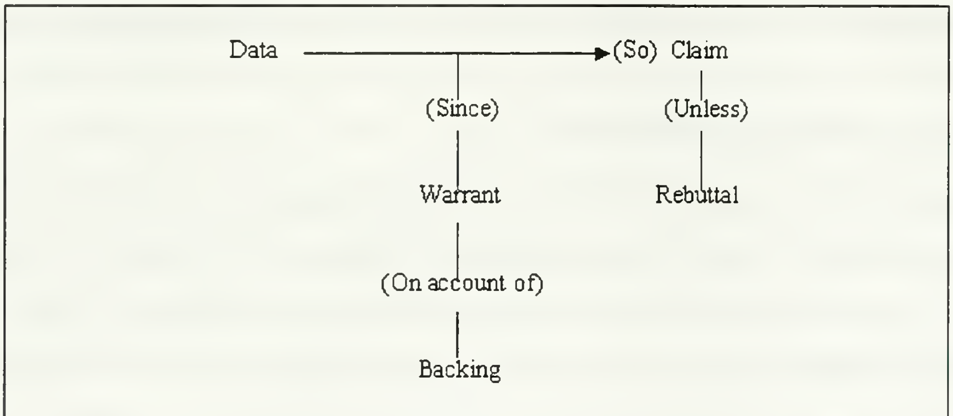
a. Diagramming Arguments

Toulmin proposed a logical structure to depict deliberations.[49] The graphical result of his structure was argument diagrams. He believed that the primary purpose of argumentation was to justify assertions. An example of Toulmin's diagramming technique is shown in Figure 4. The figure depicts an argument decomposed and diagrammed into five components. A Data element can be used to assert a Claim using a Warrant as a logical step. The Warrant is valid because of its Backing, and any Claim may have exceptions noted by a Rebuttal.

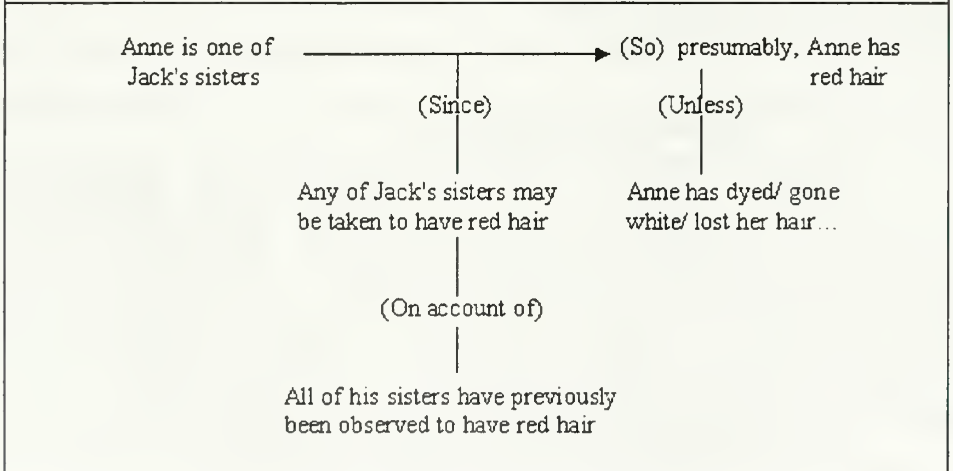
---

[49] Toulmin SE, *The Uses of Argument*, First Edition, pp. 95-145, Cambridge at the University Press, 1958

Toulmin made two major contributions in developing this diagram. He challenged the adequacy of Aristotelian logic for completely describing an argumentative process, and he graphically divided an argument into five well-defined spaces that could be used for cataloguing, comparison, and study. Although researchers have not continued to use these same five aspects of arguments, they have devised other systems in a similar fashion. Toulmin's work was revolutionary in being able to describe the parts of an argument in a meaningful and repeatable fashion, and remains the cornerstone of graphical depiction of argumentation.



(a) Generalized Toulmin Framework


Anne is one of Jack's sisters
(So) presumably, Anne has red hair
(Since)
(Unless)
Any of Jack's sisters may be taken to have red hair
Anne has dyed/ gone white/ lost her hair...
(On account of)
All of his sisters have previously been observed to have red hair

(b) Sample Utilization of Toulmin Framework

Figure 4: An Example of the Toulmin Diagramming Technique
(From Toulmin[49])

b. Intellectual Augmentation at the Human Computer Interface

Engelbart provided a vision of computerized systems being used to augment human intellect.[50] He suggested computers could provide an "increasing capability of a man to approach a complex problem situation, gain comprehension to suit his particular needs, and to derive solutions to problems." This theoretical paper established the visionary benefit of capturing argumentation.

Englebart described a system he called, H-LAM/T-- Human using Language, Artifacts, and Methodology, in which he is Trained. He discusses the human computer interaction and recognizes the importance of systematic representational schemata in maximizing the interface. The value of representation is captured in this quote:

> ...a basic hypothesis of our study is that better concept structures can be developed-- structures that when mapped into a human's mental structure will significantly improve his capability to comprehend and to find solutions within his complex-problem solving solutions.[50]

This idea of improved representational schemata has been the goal of computerized thought augmentation tool developers since that time. The different types of nodes and links in the diagramming scheme of each computerized rationale capture tools exemplifies the continued search. As noted previously, advancement in representational schemata is critical to integrating thick knowledge capture into practical knowledge management tools.

---

[50] Engelbart DC, *A Conceptual Framework for the Augmentation of Man's Intellect*, in Vistas in Information Handling, Volume 1, eds: Howerton PW, Weeks DC, pp.1-29, Sparton Books, 1963.

c. *Solution Methods for Wicked Problems.*

In 1970, Rittel described the first Issue Based Information System.[51] The system used argumentation to help resolve what he called, "second generation problems" (eventually renamed wicked problems). He felt there was a need for argumentation to resolve these problems and recommended, "...investigations into the understanding of designing as an argumentative process; where to begin to develop settings and rules and procedures for the open-ending of such an argumentative process; how to understand designing as a counterplay of raising issues and dealing with them, which in turn raises new issues, and so on and so on."[52]

Rittel felt that argumentation was needed because no single person possessed the expertise to solve a wicked problem and therefore a collaborative method was necessary to stimulate the expertise of each participant. Argumentation stimulated that expertise and forced each participant to delineate assumptions. This had an added benefit of minimizing the ability to hide moral judgments within solution options.

d. *Historical Summary*

These three works represent major milestones in the development of argumentation based design rationale capture. Toulmin challenged the adequacy of the simple syllogism for describing arguments and provided the first diagramming scheme for analyzing arguments. Engelbart's contribution was mainly in terms of human computer interaction. He emphasized the ability of the computer to augment intellect but realized that the interface itself was critical. Engelbart led the field in developing usable and meaningful representations for thought. Finally, Rittel applied argumentation to wicked problems and demonstrated the practical value of the methods. His development of Issue Based Information Systems utilized Toulmin's argumentation diagramming methods but changed the scheme to a three node representation that was more usable and meaningful to collaborative processes.

---

[51] Kunz W, Rittel HWJ, *Issues as Elements of Information Systems*, Center for Planning and Development Research, Working Paper No. 131, University of California Berkely, 1970.

[52] Rittel HWJ, Grant DP, Protzan JP, *Second Generation Design Methods,* (1972 Interview) in Developments in Design Methodology, eds. Cross N, pp.317-327, John Wiley and Sons, 1984

C. ARGUMENTATION CAPTURE METHODS

Since these early works, several methods have been developed to capture design rationale using argumentation. The various approaches lie on a continuum from narrative to retrospective.[53] The main approaches include Issue Based Information Systems, Design Space Analysis, Decision Representation Language, and Claims-Analysis. Each is discussed for its overall philosophy and then the two most similar graphical techniques are compared at the representation level to demonstrate the subtle differences in philosophy and construction. Other methodologies exist but are generally derivatives of these fundamental approaches.

1. Issue Based Information System- IBIS

IBIS was proposed by Rittel.[51] It is a narrative tool specifically designed to assist the resolution of wicked problems. Its goal is to capture the design process as it happens.[54] IBIS is used during design meetings to help structure the meetings, capture the process of the meetings by preserving the order in which events occurred, and by tracking the process by which a particular design evolves.[53]

The notation used is a three layer system of issues, positions, and arguments. There are graphical and text based versions of IBIS. The text based version uses indented text to note the relationships between layers. The graphical method uses a set of three node types, Issues, Positions, and Arguments connected by a set of links.

---

[53] Buckingham-Shum SJ, *A Cognitive Analysis of Design Rationale Representation,.* Doctoral Dissertation, Chapter 2, Department of Psychology, University of York, UK, 1991.

[54] MacLean A, Young RM, Billotti VME, Moran TP, *Questions, Options, and Criteria, Elements of Design Space Analysis,* in Design Rationale Concepts, Techniques, and Use, eds: Moran TP, Carroll JM, pp. 53-105, Lawrence Earlbaum Associates, 1996.

2. Design Space Analysis - QOC

Design Space Analysis documents Questions, Options and Alternatives to explore the decision space retrospectively. Specifically, the QOC methodology was developed as a reflective tool for designers to see if the design space was adequately explored. It does not provide a record of how the discussion unfolded like IBIS. The approach is designed to be used as an exploration tool; to view how a specific alternative rests in relation to other alternatives within the decision space. After a conversation is captured, questions can be reformulated and the design space reorganized as needed to clarify and communicate. The goal is to develop a logically coherent representation of the design space.[53]

3. Decision Representation Language- DRL

Decision representation language provides a much more complex and encompassing expression of decision rationale than either IBIS or QOC representations. Like design space analysis, DRL is used asynchronously and retrospectively. The user captures the discussion and then manipulates the information into an appropriate representation.

The language describes five spaces as opposed to three in IBIS and QOC. The spaces and their related representations are the Issue space represented by *Decision Problems*, the Alternative space represented by *Alternatives*, the Criteria Space represented by *Goals*, the Argument space represented by *Claims*, and the Evaluation space represented by non-specified labels of value such as *Is a Good Alternative for*, or *Achieves*.[43]

The increased complexity of the language allows for more complete description of the design process. For example, in QOC there may be cross option dependency but there is no way to show it in the model. DRL provides for such complexities in its vocabulary. The main benefit of DRL is it is actually a representation language that allows a higher level of communication than a simple model of a conversation or decision space.[43]

4. Psychological Design Rationale- Claims Analysis

Psychological design rational is based on the recursive relationship between tasks and designed artifacts. Tasks present a set of requirements that lead to an artifact. The artifact then allows a user, who was unaware of what was possible, to think of new ideas and new tasks that may lead to new requirements, and so on. By monitoring this iterative process, specific claims about new tasks, requirements or possibilities can be gleaned and used as rationale for future design work.[55] Carroll and Rosson developed this theory because of, "...the observation that situated artifacts serve as embodied theories in the practice of human computer interaction." Their goal was to make that observation useful.

5. Comparison of QOC to gIBIS

Both QOC and gIBIS (The graphical form of IBIS, referred to as IBIS here on.) use a three node system. QOC uses Questions, Options, and Criteria while IBIS uses Issues, Positions, and Arguments. As noted previously, IBIS is for use in real time while QOC is designed for retrospective analysis. In that regard, the two are complements rather than substitutes.

The three parallel node types are compared in Table 2. An IBIS Issue is more general than a QOC Question in that an Issue can relate to anything brought up in the conversation while a Question specifically relates to a design element. IBIS Positions and QOC Options are indistinguishable in that they resolve the issue or answer the question.

---

[55] Carroll JM, Rosson MB, Deliberated Evolution: Stalking the View Matcher in Design Space,, in Design Rationale Concepts, Techniques, and Use, eds: Moran TP, Carroll JM, pp. 107-145, Lawrence Earlbaum Associates, 1996.

The IBIS Arguments and QOC Criteria are very different in their definitions. IBIS Arguments are simply statements that either support or object to the positions to which they are related. QOC Criteria provide the bases for evaluating and choosing among the Options and satisfy specific characteristics. A criterion: 1) measures a property of the artifact that the designer controls by exercising choices over Options, 2) is unconditional in the sense that the greater the extent the criterion is met, the better the design, 3) is evaluative; a measure of some property of the artifact with a higher assessment value being better, and 4) potentially yields a quantitative value, even if only on an ordinal scale.

A Table of Node Definitions for IBIS and QOC		
Node	IBIS	QOC
1	Issue Articulation of key issues in the design problem.	Question Poses key issues for structuring the space of alternatives.
2	Position A statement or assertion that resolves the Issue. Often Positions are mutually exclusive of one another but not required by the method.	Option Possible alternative answers to the question.
3	Argument Each position has one or more arguments which either supports or objects to that position.	Criteria The bases for evaluating and choosing among the Options. -Measures a property of the artifact. -Unconditional -Evaluative -Potentially yielding a quantitative value

Table 3: A Comparison of IBIS and QOC Nodes

Another area of difference between the two systems is in the expressiveness of the links between nodes. IBIS has nine types of links to connect nodes. For example, a Position *Responds-to* an Issue. Arguments are linked to Positions by *Objects-to* or *Supports* links. Issues may *Generalize* or *Specialize* other issues and may also *Question* or *Be-Suggested-by* other Issues, Positions, or Arguments. The link types are color coded to facilitate intuitive understanding of the overall conversation on first glance. QOC does not use expressive links except for Criteria to *Support* or *Challenge* Options. The diagram in Figure 5 demonstrates several of the color-coded links in the IBIS representation from a commercially available software product. Figure 6 depicts a QOC representation for a similar issue. Appendix A contains QOC diagrams from a commercially available software product.

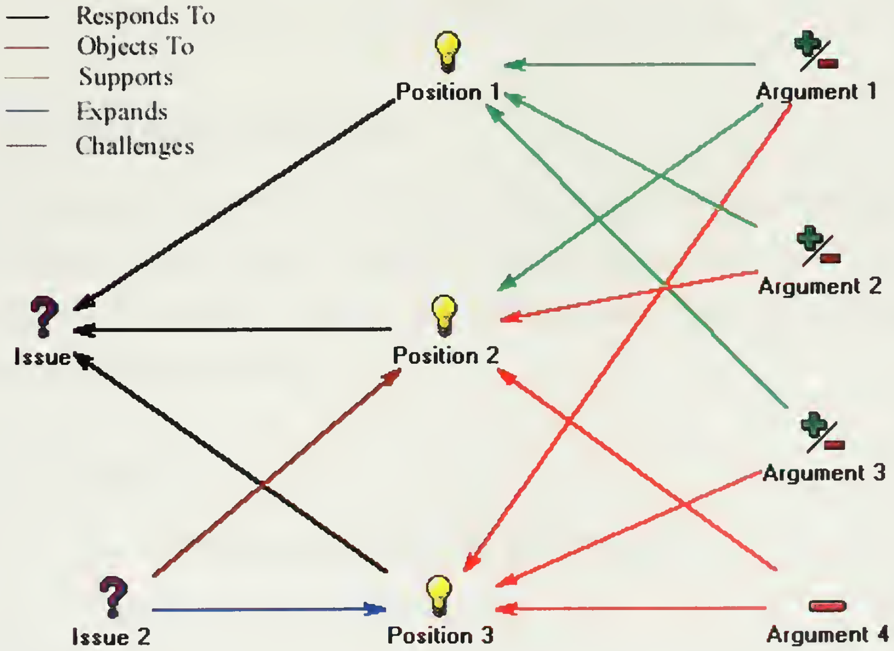


Figure 5: A Sample IBIS Representation

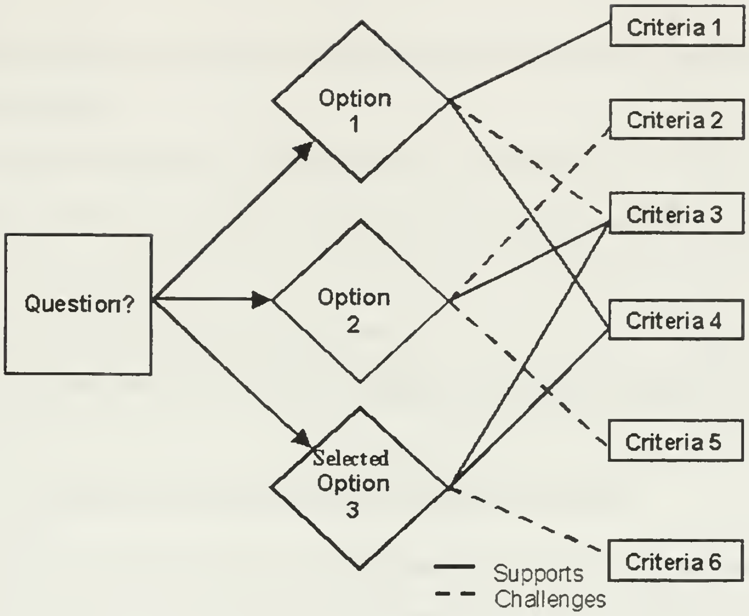


Figure 6: A Sample QOC Representation

D. LESSONS FROM INDUSTRY

Capturing design rationale has been attempted in several industrial settings, most notably software development. Academic experimentation has also been completed yielding significant insight to its use. This section summarizes some of these lessons learned from previous experience.

1. Benefits

a. Organizational Memory and Learning

Captured design rationale have been shown to be beneficial to organizational memory and learning in several ways. Six studies and their elucidated benefits are listed as summarized by Shum, et. al.[56]

- Clarifying vague requirements, and tracking the rationale for their inevitable

---

[56] Buckingham Shum SJ, MacLean A, Bellotti VME, Hammond NV, *Graphical Argumentation and Design Cognition,* Human-Computer Interaction, v.12, pp.267-300, 1997.

evolution.[57]

- Representing multiple stakeholders' viewpoints, including that of end users in participatory design.[58]
- Negotiating trade-offs between multidisciplinary analyses.[59]
- Maintaining consistency in decision making, for example through propagating changes throughout networks.[60]
- Communicating rationale to other designers.[61]
- Building cumulative design knowledge, through systematic reuse of rationale.[55]

b. Enhanced Discussions and Design Meetings

Semiformal documentation of argumentation during discussions or design sessions using IBIS or QOC tools decreases the "answer reflex." The answer reflex is where participants become more concerned with having the right answer than understanding what the actual issue is being discussed.[62] This reflex is decreased by the decomposition aspect of the structure. By forcing the conversation into issues, positions and alternatives the participants are able to more clearly see the actual discussion point and how their input affects the outcome. Four definable benefits are realized in this manner: unbundling, classification, naming, and structuring.[63]

---

[57] Potts C, Takahashi K, Anton A, *Inquiry Based Requirements Analysis,* IEEE Software, pp.21-32, March, 1994.

[58] Sjoberg C, Timpka T, *Inside multidisciplinary design in medical informatics: Experiences from the use of an argumentative design method*, Proceedings of the MEDINFO '95 Tri-Annual World Conference in Medical Informatics, Vancouver, http://www.mrc-apu.cam.ac.uk/amodeus/abstracts/cp/cp76.html, 1995.

[59] Bellotti VME, Buckingham Shum S, MacLean A, Hammond N, *Multidisciplinary Modelling in HCI Design...In theory and in practice*, Proceedings of CHI'95 Conference on Human Factors in Computing Systems, pp 146-153, 1995.

[60] Lee J, *SIBYL: A qualitative decision management system*, in Artificial Intelligence at MIT, eds. Winston P, Shellard S, pp.105-133, MIT Press, 1990.

[61] McKerlie D, MacLean A, *Reasoning with Design Rationale: Practical experience with design space analysis*, Design Studies, v.15, pp.214-226, 1994.

[62] Conklin EJ, *The IBIS Manual- A Short Course in IBIS Methodology*, Working Paper, Group Decision Support Systems, Inc., pp.1-19, 1996.

[63] Buckingham Shum S, *Negotiating the Construction and Reconstruction of Organizational Memories*, Journal of Universal Computer Science, v.3, pp. 899-928, 1997.

Unbundling consists of forcing the parts of a statement to be delineated. A conversation participant may offer a possible solution to an issue with two or three arguments for or against it at the same time. Unbundling the statements and separating out exactly what is being said minimizes arguments about small parts of large statements.

Classification is the identification of a statement as an issue, position, or argument (question, option, or criteria if using QOC). Simple semantic changes may make an option sound like a criterion. Understanding the statements and their relationship to one another helps structure the discussion and keep all participants focused.

Naming is part of the organizational knowledge ontology. Names need to be succinct but informative such that future teams can easily find what is needed or existing teams can review their work several months later into a project.

Structuring involves the mechanics of diagramming and how the individual elements relate to one another. Whether a question is sufficiently different than another to warrant a new node or how one criterion relates to an option, etc.

2. Costs

a. Overhead

The cultural change needed to move from a document-centric system to a process-centric system is more than just a change in thought processes. Fiscal investments are needed. Computerized tools have a finite cost but the greatest cost is in dedicated personnel to capture and store the knowledge. Librarianship is also a critical factor in successful utilization of any knowledge capture system. An entire hierarchical network of knowledge workers may be required in a large organization starting with a Chief Knowledge Officer at the executive level, down to "front-line" personnel trained in the tools and methodology. Businesses must be convinced of financial rewards greater than the overhead costs incurred, and those rewards must be realized, if the process is to continue.

b. Reward Systems

Significant philosophical changes in human resources policies are needed to make knowledge capture a central part of an organization. Reward systems for promotion, performance appraisals, and so on, must encourage the capture of process knowledge. Many projects are not tested or fielded by the same groups or personnel who design them so there is little motivation for designers to capture the process, even though the benefit may be great to the company overall.

For example, in software development, maintenance consumes 60-90% of life cycle development costs. This suggests any capture investment during design will payoff many times over after fielding. However, most software projects are not completed and designers are not typically rewarded for good documentation. Conventional corporate reward systems encourage a project to finish on time and within budget, even if that means providing less than optimal documentation for the next group to use (if a project is completed). New reward systems are needed that emphasize the benefit of knowledge capture throughout the development process.

Reward systems must also be developed to encourage group work and group participation. Many workers are distrustful of others or unwilling to share ideas for fear of lost recognition. Reward systems encouraging group work will enhance the outcome of development projects and help move a company toward a process-centric philosophy.

E. CONCLUSIONS

Managed care medicine deals in the resolution of wicked problems. These problems are both theoretically and experimentally shown to benefit from using argumentation techniques in their resolution. Argumentation provides an orderly examination of the problem and stimulates the expertise of multiple participants such that a solution for the particular situation and time may be found. At the same time, argumentation can be used to capture the process knowledge gained during the resolving process so the lessons learned in resolution are not lost for the next group working on the problem.

Capturing process knowledge in medical practice policy and guideline development will provide an opportunity for physicians to retrospectively review the design process. Allowing every physician the ability to improve and continuously modify existing rules sets provides physicians autonomy, an important parameter of physician satisfaction, as discussed in Chapter II.

The incurred overhead and cultural changes necessary to implement argumentation capture into an existing system are not insignificant. Change management emanating from the highest levels in an organization will be needed to successfully implement these knowledge management practices. The overall value of knowledge management within the organization must be considered before such a project is undertaken. And a formal plan involving all aspects of the organization is needed to facilitate a knowledge culture consistent with successful knowledge management projects.

V. IMPLEMENTING DESIGN RATIONALE CAPTURE IN MANAGED CARE

A. INTRODUCTION

This thesis offers design rationale capture as an instrument for bridging the organizational design of managed care to the environment of traditional medicine. The previous chapters have focused on the theoretical basis for both design rationale tools and the organizational misfit of managed care in the environment of traditional medicine. If capturing design rationale is going to be used as a mechanism for improving managed care, then it will have to be embraced by the users. Users will need to understand the utility of any such system. This chapter focuses on the critical success factors for implementing this tool in the environment of managed care.

Capturing design rationale is a type of knowledge management project. A general examination of knowledge projects in industry is used to outline the elements common to successful knowledge management projects. Lessons from software engineering are then used to suggest appropriate problem and project types for capturing design rationale. A case study of a critical pathway development in a small community hospital is then provided. The case study, analyzed in Chapter VI, demonstrates many aspects of medical policy development and implementation that are necessary to consider prior to establishing design rationale capture as a tool for improving managed care.

B. ELEMENTS OF SUCCESS

1. Industry Survey

Davenport and Prusak studied 31 knowledge management projects in 20 different firms to find common elements of successful projects.[64] Success was defined as any of the following five parameters:

- Growth in resources attached to the project.
- Growth in the volume of knowledge content and usage.
- The likelihood that the project would extend beyond an individual.
- Comfort throughout the organization with the concepts of knowledge and knowledge management.
- Evidence of financial return.

The study was conducted by site visit in some cases, but mostly through telephone interviews with managers. It was relatively subjective by design but nevertheless provided insight to the nature of knowledge management projects. The study revealed nine factors common to successful projects. The following list with descriptions is taken directly from Davenport and Prusak.

a. A Knowledge Oriented Culture

There is a positive orientation to knowledge. Employees are bright and intellectually curious, are willing and free to explore, and their knowledge-creating activities are given chances by executives. There is an absence of knowledge inhibitors in the culture: people are not resentful of the company and do not fear that sharing knowledge will cost them their jobs. And the knowledge management project fits the culture. For example, a hierarchical company does not have distributed knowledge projects.

b. Technical and Organizational Infrastructure

Compatible hardware systems are in place that are usable and accessible. Appropriate software is installed for use by everyone who needs it. Personnel are in roles that can manage and use the knowledge. Mechanisms are in place to capture, store and retrieve the knowledge.

c. Senior Management Support

Management sends out messages to the organization that knowledge management and organizational learning are critical to the organization's success. They clear the way and provide funding for infrastructure. And they clarify what types of knowledge are important to the company.

d. A Link to Economics or Industry Value

Some sort of business case analysis is done on the project. For example, a cost benefit analyses could be done that may include tangible and intangible items.

e. A Modicum of Process Orientation

Organizations that understand the value of process knowledge tend to be more successful with knowledge projects.

f. Clarity of Vision and Language

Terminology in describing and implementing the project must be clear. Confusing words such as "knowledge," "cultural change," or "learning" should be left out of policies and discussions about the project.

---

[64] Davenport TH, Prusak L, *Working Knowledge: How Organizations Manage What They Know*, pp. 141-161, Harvard Business School Press, 1998.

g. Nontrivial Motivational Aids

Reward for engaging in the knowledge project must be non-trivial. Effort is needed to document process knowledge and workers need to understand its value. Notations on performance appraisals and financial incentives are examples of nontrivial motivational aids.

h. Some Level of Knowledge Structure

The repository of knowledge must be usable. Developing an organizational schema for the particular knowledge type makes the knowledge more accessible and retrievable.

i. Multiple Channels of Knowledge Transfer

Knowledge can be transferred in many ways. Keeping multiple avenues for knowledge transfer open including "face time" facilitates the transfer of knowledge between workers.

2. Summary

Davenport and Prusak's findings can be grouped into three categories: the need for a knowledge-oriented culture, human and computer infrastructure, and senior management support. Without these three elements a knowledge project is likely to fail. Of these, senior level support is probably the single most important. The others are likely to follow or be easier to attain if there is support from above. Any marketing of ideas to managed care organizations should target these three areas. Specifically, senior management must be sold on the idea of creating an infrastructure, but they will only be sold if they can see the value of a knowledge-oriented culture.

C. SUGGESTED USES

1. Problem Selection

Rittel described IBIS as a method for solving wicked problems. He saw a need for different methods to approach these problems as compared to the conventional methods used for tame problems. Interestingly, just as tame problem solving methods do not work for wicked problems, the argumentation methods used for tackling wicked problems are not conducive to tame problem solving. In fact, argumentation methods may inhibit tame problem solving. In an experiment examining the use of QOC tools during computer interface design, designers found the tools useful while in the initial "strategic" level solution phase but a hindrance at the lower levels of design.[56]

The researchers proposed the designers' experience was due to using the tool in a design space *evaluation* mode rather than a design space *exploration* mode. Argumentation is best for wicked problems that are poorly understood. Once the design space is well understood the problem becomes tame and a process of multiple constraint satisfaction occurs rather than the exploratory process of overcoming wicked problems.

2. Project Selection

Grudin examined four software project scenarios to identify project types that may have a high likelihood of success using design rationale capture.[65] He examined "off the shelf" product development, "in-house" product development, competitively bid contract product development, and customized software development. His work is briefly described here.

---

[65] Grudin J, *Evaluating Opportunities for Design Capture,* in Design Rationale Concepts, Techniques, and Use, eds: Moran TP, Carroll JM, pp.453-470, Lawrence Earlbaum Associates, 1996.

a. "Off the Shelf" Product Development

"Off the shelf" product development has a high failure rate (66%-90%) eliminating the maintenance phase for most starts. Projects are often built at different sites on different platforms making capture tool utilization difficult. And developers are unlikely to utilize the rationale artifact since updates and new releases are developed by different teams in many situations. The only benefit of rationale capture to this system of development is getting new project personnel "up to speed" and educated on previous efforts.

b. "In-House" Product Development

"In-house" product development has a relatively low completion rate (25%) but the maintenance phase for completed projects is likely to be done by the same team. Unfortunately, in-house projects are often low on innovation and low on funding so rationale capture tools and the expense of increased overhead may not be viable in this environment.

c. Competitively Bid Contract Development Projects

Competitively bid contract development projects have a very high completion rate because of contractual obligation. Extensive documentation is also required in most contracts so this environment may appear ripe for rationale capture. However, design and maintenance are often carried out under separate contracts using separate teams. The added expense of the design rationale combined with reward systems based on completion schedules and budgets do not provide an environment conducive to capture.

d. Customized Software Development

Customized software development projects hold the most promise for successful implementation of design rationale capture. These projects are often in small "niche" markets. The projects have a high rate of completion and are often developed by small teams who will also maintain the product after completion. Also, once a niche is established, similar projects may be encountered, further emphasizing the benefit of captured design rationale.

e. Summary

Before starting a design rationale capture project, the audience for the captured material must be considered. Grudin's work demonstrates that in today's environment the ultimate project for documenting design rationale is one that will be taken to completion and continue its life-cycle through a maintenance phase. The project's design team performing the capture should be a direct beneficiary of the result as opposed to future groups or teams. If the audience using the rationale product is the same as the one creating it, then there is a much better chance of successful utilization.

3. Use in Managed Care

Lessons from industry suggest managed care organizations will have a high likelihood of successful process knowledge capture during endeavors such as critical pathway and practice guideline development. The problems are generally wicked and require an exploratory process for resolution. There is a high rate of project completion and the teams creating the pathways and guidelines are direct beneficiaries of the finished designs. Post development maintenance on the protocols is often accomplished by at least some of the same team members or at minimum other members of the organization who have been, and will continue to be, beneficiaries of the results. There is also a high probability of future, similar endeavors within the organization.

D. CASE REPORT

1. Background and Setting

This case takes place in a 179-bed community hospital. The governance structure of the hospital starts with the Leadership Committee that includes the CEO, hospital executives, and senior medical representatives. The committee has chosen to use the clinical [critical] pathway to seek out "best practice" recommendations for physicians in the hospital. Clinical pathways have an added advantage over other managed care tools in that they satisfy hospital accreditation requirements to demonstrate efforts toward continuous quality improvement. Pathways are developed by multi-disciplinary teams that consist of hospital personnel and physician representatives who are likely to take part in the particular disease process being evaluated.

The hospital policy on clinical pathway utilization is that physician participation is voluntary. The hospital has one pathway established and three recently developed that are in pilot phases of use. Three others are in development and one is pending team formation. So far, the one established pathway, for total hip replacement, enjoys wide acceptance among all 9 orthopedic surgeons utilizing the hospital. The other three pathways in pilot phases are not as readily accepted. Only the physician champions and perhaps a few others use them.

This case report describes part of a pathway development for the diagnosis of stroke. Stroke was chosen because it is a high volume diagnosis for the hospital and one that appeared to be losing money. The team consisted of eleven people with 4 additional ad hoc members. The membership is listed in Figure 7.

This report is based on 7 team meetings (5 complete team meetings and 2 sub-team meetings). The pathway was not completed prior to close of the data collection time window for this thesis. The author was a non-participant member of the team, present solely to observe and collect data. The design rationale capture was performed passively during the meetings and the captured knowledge is shown in Appendix A.

Stroke Clinical Pathway Team Membership

Co-Leaders: Intensive Care Unit Nurse Manager Neurologist (Physician) **Nurses:** Emergency Room Nurse Inpatient Ward Nurse Home Health Nurse **Physicians:** Emergency Room Physician Internal Medicine Physician Internal Medicine Physician (Ad hoc)	**Ancillary Services:** Physical Therapist Clinical Pharmacist Cardio-Pulmonary Technician Dietician Patient Relations Representative (Ad hoc) Hospice House Representative (Ad hoc) Medical Records Representative (Ad hoc)

Figure 7: Clinical Pathway Design Team Membership

2. Meetings

At the first meeting, a brief training was provided by the Director of Education in the hospital. The training consisted of providing the hospital definition of a clinical pathway and having the team set ground rules for themselves. The ground rules developed by the team are shown in Figure 8. The hospital definition of a clinical pathway is:

> ...an interdisciplinary patient management approach outlining the combination and timing of clinical practices for a specific medical condition or procedure that result in clinically appropriate care with efficient management of resources. Each pathway is based on available data regarding best practice and expert consensus.[66]

During the training, some of the members expressed the feeling that because of the voluntary nature of utilization they needed to find ways to sell the new pathway to physicians. Others believed "selling" was not necessary since there would be some physicians who would try the pathway immediately and others who would not, thereby setting up a natural experiment for effectiveness.

---

[66] Handout to Development Team from Director of Education at the Hospital.

Stroke Clinical Pathway Team Ground Rules

1. Mutual respect, directness, honesty in communication.
2. Professionalism
3. Courtesy:
   - Wait turn
   - no interruptions
   - no overtalk/finish thought
4. Decision making:
   - Majority rule
   - Defer to discipline representative
   - Consensus goal, only open "votes" to group where the group has need.
5. Start on time/ End on time
6. Interruptions- Pager/Phone Call
7. Information available if meeting missed.
8. Notify Team Leader if unable to attend.
9. Concise focus (no rambling)
10. Be consistent with organizational values.
11. Need to support consensus.
12. Use "guidelines" when available to develop pathway.
13. Be open to change.
14. Acknowledge conflict and address before moving on.
15. Provide food.

Figure 8: Clinical Pathway Design Team Ground Rules

After the initial training, a representative from Financial Services presented data about stroke patients over the past year. The purpose was to provide information to the team so they could better define their mission. The coding system used in medicine throughout the country is markedly complex. It was difficult for the group to understand all the data, however, it appeared that there may be disparity between financial results in types of strokes. Overall, the diagnosis of stroke was losing money for the hospital, but when divided into ischemic and hemorrhagic subtypes, it appeared that hemorrhagic strokes were the cause of that loss even though it occurred much less frequently.

This latter thought posed the first issue for the team. Clinical pathways are generally designed for high volume diagnoses or procedures where standardization will have the largest impact, but it appeared from the data that the low volume stroke type (hemorrhagic) was the major cause of financial loss. The difference in volume was approximately 10 to 1. To complicate things further, it was not clear that the methods used for coding were consistent between practitioners. This meant that the hospital would be reimbursed at very different rates for two patients with very similar medical courses and lengths of stay in the hospital. The difference was simply due to different billing codes chosen by the doctors or by the manner in which discharge summaries were written.

The allotted time ran out so plans were made for the next meeting. Financial Services was asked to reorganize the data such that ischemic and hemorrhagic stroke could be more easily delineated. The team decided that meeting every two weeks would be appropriate but none of their schedules matched yet so the next meeting would be in three weeks.

At this point the team saw four possible options for a primary mission: 1) develop a pathway for ischemic stroke because it is high in volume even though it does not appear to be losing money, 2) develop a pathway for hemorrhagic stroke because it appears to be the money loser even though it is a low volume diagnosis, 3) develop a combined pathway for both types of stroke, or 4) disband and recommend a new team be formed to evaluate coding practices. Little consideration was given to the last option but it was thrown out on the table for discussion. It was also noted that hemorrhagic stroke has a markedly more diverse course than ischemic stroke because of the frequency of significant co-morbidities.

Over the course of the next two meetings it was decided to develop a pathway for ischemic stroke. The final rationale was that they may be able to make a combined pathway but the hemorrhagic portion may be so complex that it would be difficult to know when to keep a common path and when to divide into two separate paths. The decision was to create the ischemic stroke pathway and then revisit the issue of including a hemorrhagic portion later when they will be better able to evaluate how the ischemic pathway would be affected by the additions.

The team also felt that the hospital did not have a cohesive sense of stroke care so the development of the ischemic stroke pathway would bring to the forefront several issues that are good for the community and overall patient care. The team specifically noted that their mission, although to be cost conscious, was to provide the best possible care to their patients. In that regard, the major portion of the second meeting was spent developing an opportunity statement to give to the Leadership Committee. That opportunity statement is shown in Figure 9.

Stroke Clinical Pathway Team Opportunity Statement

Development of the stroke clinical pathway provides an opportunity to:

-improve functional outcome of stroke patients
-improve patient quality of life
-improve quality and consistency of care
-improve efficiency of care
-reduce lengh of stay
-reduce cost
-clarify patient expectations of stroke care and outcomes
-improve patient education
-improve and optimize rehabilitation potential
-improve knowledge and practice patterns of health care providers
-improve patient, physician, and staff satisfaction with stroke patient management

Figure 9: Clinical Pathway Design Team Opportunity Statement

The discussion through the first 4 meetings mainly focused on how to go about the task of creating the pathway. It was not uncommon to hear members comment on the complexity and difficulty of the task. Other than a large amount of time being spent on the opportunity statement, the conversations jumped from subject to subject but tackled many of the peripheral issues. These included important items such as where patients should be admitted to the hospital (through the emergency room or directly to the ward), whether to include patients treated with a controversial medication known as t-PA, as well as administrative items such as what the order page should look like and whether only mandatory items should be included or whether they should include optional items as a reminder to physicians. They also established the need for a chart review and discussed items to be reviewed. Although these are all necessary items to consider, by the end of the fourth meeting there was frustration expressed by multiple members about the lack of progress and the need to move ahead with development. It was decided to form a sub-team to start developing a set of doctor's orders and then bring the suggested set to the full team for discussion.

The sub-team method proved to be productive and at the next full meeting, time was spent evaluating the proposed orders and then forming several sub-teams to task with various issues relevant to the pathway. This was the final full-team rationale capture in this thesis. The rationale underlying decisions made at the original sub-team and one subsequent sub-team meeting were also captured.

3. Structure and Administration

The format of the team meetings was a two-hour, open discussion, based on an agenda created for each meeting by the nurse co-leader. The agenda was made with input from the team at the end of each previous meeting. At every meeting a timekeeper and recorder was identified. The nurse co-leader began each meeting and tried to follow the agenda. Discussion on various agenda items would often run over the allotted time.

On one occasion, the physician co-leader chose to interject an agenda item without consultation of the nurse co-leader or team membership. He described a stroke clinical pathway he helped develop at another hospital and the reasons why it was structured as it was and why several of the items were on the pathway. When time ran out in the meeting, he recommended for each of the members to consider input for a pathway from their area of expertise. The remaining agenda items were tabled until the following meeting.

Attendance was generally good. However, some members were less consistent than others. For instance, the attendance of the physician co-leader was erratic, either late or absent for each meeting. Others who had conflicts were cooperative in contacting the nurse co-leader and explaining the situation.

Finally, there was a lack of consistency with respect to scheduling meetings. Although there was agreement at the first session that meetings should occur every two weeks, this never happened. At the end of each meeting when it came time to schedule the next meeting enough people could not accommodate the two week interval, so that meetings were generally three to four weeks apart. Once sub-teams were formed, they would meet in the interim periods between full team meetings but the planned 2-week interval was never met.

E. CONCLUSION

This chapter focused on parameters for consideration when implementing design rationale capture in managed care environments. Elements of successful knowledge management projects in industry emphasize the need for infrastructure, cultural change, and high-level support. Experiments in design rationale capture during software development suggest medical practice policy formulation possesses many of the characteristics of programs that have had a high rate of success using rationale capture. The case study of a clinical pathway development was provided to investigate the current state of affairs in managed care medical policy development and how capturing design rationale may improve the process. In the next chapter an analysis of the case study is undertaken and a strategy for improving the process is devised.

VI. CASE ANALYSIS AND A NEW STRATEGY FOR MANAGED CARE

A. INTRODUCTION

Medical practice policies are developed based on existing knowledge and then disseminated for utilization. Physicians are expected to accept the knowledge inherent to the policies and follow them. One of the causes of failure in the system is its document-centric nature (Chapter III). As noted previously, physicians desire to see if their own practice patterns were considered in the development of the policies. In that regard, migration toward a process-centric system would lead to a higher likelihood of physician acceptance.

This chapter provides a strategy for implementing practice policies in a more process-centric manner that will improve the fit of managed care to the environment of traditional medicine. The case study from Chapter V is first evaluated as a knowledge management project using Davenport and Prusak's findings regarding successful knowledge projects. The analysis provides insight to methods of improving the development process, and suggests ways of improving physician acceptance. However, improving the process alone is not sufficient due to the power structure within medicine. The strategy managed care uses to implement its policies must be changed to fit the power structure of the system. A recently described framework for coping with wicked problems, specifically based on power relationships, is given to help devise a strategy for improving managed care. Two scenarios for implementing that strategy are then provided.

B. CASE ANALYSIS

The case report from Chapter V is analyzed in relation to findings from Davenport and Prusak's survey of successful knowledge projects. Specifically, it is analyzed with respect to senior leadership support, adequacy of organizational and computer infrastructure, and the knowledge orientation of the culture. In each section the analysis is done at the level of the team development and then extrapolated to the overall implications for managed care. Much of the analysis does not involve design rationale directly. This section is specifically used to emphasize the need for a systems approach to any knowledge management project. Design rationale capture will not stand on its own as a solution to the failure of managed care. It is a tool for use in an overall structure as described in this analysis. The context of the organization must be considered when implementing any new process for improvement.

1. Senior Leadership Support

a. Effect on the Development Effort

The Leadership Committee at the hospital sends mixed messages to the development team and the hospital at large about the significance of clinical pathways. The pathways are important enough to convene multidisciplinary teams that spend many hours in development sessions, but the efforts at implementation suggest the pathways are a low priority. These messages may affect physician acceptance of the clinical pathways and managed care principles.

Poor physician compliance with critical pathways is well documented in the literature as noted in Chapter I. This failure is consistent with the attachment to practice patterns and desire for autonomy described through the Galbraith framework in Chapter II. The fact that the hospital has one pathway in successful use is encouraging, however there are three others without good success and three more in development.

If senior leadership is serious about making clinical pathways work then they need to send the message that the pathways are indeed important. At the first team meeting the “kick-off” event was the brief training by the Director of Education. It is important to realize that this first meeting sets the tone for the team. A five-minute appearance by a member of the Leadership Committee to explain the importance of the work and the expectations of the Leadership Committee would impart a much higher level of importance to the project in the members. This kind of exposure is frequently discussed in hallways and sparks an interest that may change the manner in which pathways are viewed within the hospital.

Another factor that suggests pathways are a low priority item is the sliding timeline. The Leadership Committee decided to charter the stroke pathway team in November but the team did not have its first meeting until May. This level of prioritization carried over into the development team who were never able to meet the two-week meeting schedule despite agreeing to so at the start.

The Leadership Committee is, however, forming a team to find ways to motivate physicians to use the pathways. No further pathways will be developed until lessons can be learned about implementing the pathways currently in place and in development. These efforts are commendable but probably insufficient in the face of other factors discussed throughout this analysis.

b. Implications for Managed Care

Senior leadership support for the development and implementation of practice policies is crucial to their success. The policies effectively change the fundamental thought processes for physicians. Rather than relying solely on their training and expertise for answers, physicians are asked (or required) to consult rule sets and policies devised by a team of people they may not know. They also do not have the opportunity to see why the policies are designed as they are. This is a major change to their manner of practice and should be handled with all the change management skills possible. Simply developing the policies and putting them out for use is a set up for failure, as experience has confirmed.

The voluntary participation rule brings up the question of an optimal strategy for implementing managed care policies. It begs the question of authority and distribution of power within the organization. Hospital administrations hold a variable amount of power over the physicians depending on the particular organizational structure. In a military setting or in a wholly owned managed care organization, where the hospital belongs to the organization and physicians are salaried employees, there is abundant opportunity to exercise strict authoritative power over the physicians.

In the case study, however, the hospital is a third party to the physicians and a variety of managed care organizations. The independent physicians practice in the hospital because they choose to do so. They bring their patients to the hospital, each having one of many possible insurance plans. If the hospital were to try to implement strict policies that limit practice pattern options then the physicians may move to another hospital within the area and the hospital would risk closure. Therefore, they choose to leave their policy on clinical pathway utilization as encouraged but voluntary. In this setting, the physicians must deal with the rules and approval policies of each of the individual insurance plans, but not of the hospital. The hospital is at the mercy of the physicians to practice in a manner that is efficient, such that the hospital reimbursement will be sufficient to cover the costs of the hospitalizations. The result is that any policies within the hospital that happen to fit the practice patterns of the physicians are followed, while the others are ignored.

The key factor in both of these situations is the distribution of power. This will be discussed later in the chapter, but the power in all managed care settings is distributed between the managed care organization and the physicians. Neither exercises complete power over the other. This power distribution further emphasizes the need for senior leadership involvement. Specifically, they need to be involved with the change management aspect of policy implementation.

2. Adequate Infrastructure

a. Effect on the Development Team

(1) Organizational Infrastructure. The organizational infrastructure for pathway development in the hospital is minimal, at best. It consists of administrative support from the quality assurance office and a facilitator to develop team membership and provide general guidance and written resources for the pathway development process. There could be great benefit from staffing each team with a facilitator trained in group interaction, or at least by increasing the training sessions to include the development of team norms. The need for this is exemplified in the scenario through the difficulty of following the agenda and ground rules.

The ultimate demonstration of falling off the agenda was when the physician co-leader essentially commandeered the meeting with his own agenda item. Although potentially a productive course to request, it was done without consultation of the nurse co-leader. A trained facilitator would stop this behavior and bring it to the group for discussion with the understanding of what it will do to the rest of the agenda. If group norms were well established in the team training, then some of the other members may have felt empowered to question the interruption. Without either of these however, the dynamic appeared to default to the physician dominant hierarchy within the hospital.

It is important to realize that this commandeering appeared to be done with good intention. The physician co-leader possesses a great deal of knowledge about stroke and stroke management and brought with him experience in developing critical pathways. However, his behavior significantly undermined the organizational efforts of the nurse co-leader. His efforts, although not in congruence with those of the co-leader, may have worked if he were able to lead the team in a concerted effort, however, he was also erratic in his attendance. He missed at least one meeting and showed up markedly late to others making the commandeering nature of his discourse a disruption to the process rather than a fruitful addition. When he was not present the group was able to use several of his ideas in a more thorough, organized, discussion format.

The leadership of the teams will vary from team to team and each of the leaders will bring a different style and organizational ability. In this case, the nurse manager co-leader was well organized and attempted to follow the agenda but was occasionally derailed by the co-leader or would allow discussions to go beyond self imposed time limits. A trained facilitator could be beneficial in the team meetings to recognize when ground rules are being broken, and to focus the discussion at critical times.

(2) Computer/ Software Infrastructure. The hospital has minimal computer infrastructure to facilitate pathway development. For instance, some of the team members were without e-mail connectivity.

This is an area where design rationale capture stands to improve the process the most. The design rationale captured during the development process (Appendix A) was captured passively as the team worked. If the team actively used the organizational structure of argumentation based design rationale tools, then it is hypothesized that they would have been able to focus their efforts more clearly. The secondary effects of using these tools are discussed in Chapter IV. Briefly, they aid in teasing out issues from options, force clarity to the issues being discussed, and make the invocation of hidden agendas almost impossible.

The findings in the scenario of jumping from topic to topic, feeling that progress was poor, and needing to break into smaller teams to accomplish any work is all expected in wicked problems resolution when using traditional problem solving techniques. Rittel suggested that argumentation is needed to resolve these problems because the traditional problem solving methods of defining the problem, collecting data, and defining the solution after analysis simply do not work for wicked problems.

The process could be improved by forcing the team to define an issue, deal with that issue in a focused manner and then address other issues that come up as a result of the first issue. This would give them a mechanism for starting and moving logically between issues rather than skirting the main issues. The team demonstrated the common difficulty in wicked problems of, "Doing the easy things first" which gives some understanding of the problem as a whole but actually wastes time while the team learns to wrestle with the main problem issues. This was the basis of many of the team members' expressed frustration. The argumentation based tools are aids to the exploratory process of wicked problem resolution. It brings the type of problem solving techniques necessary for wicked problems to an organized reality, and facilitates the process.

b. Implications for Managed Care

(1) Organizational Infrastructure. Organizational infrastructure is needed in every organization trying to implement any type of practice policy. It has been shown repeatedly that voluntary participation with current techniques of documentation and implementation do not work. There needs to be facilitators to make both the development and implementation smooth. Mechanisms are also needed to encourage policy utilization.

This thesis emphasizes a knowledge management software solution for this mechanism. If these software tools are utilized then dedicated personnel will be needed for training, maintenance, librarianship, and other administrative matters attendant to the captured knowledge. Essentially, a knowledge-based infrastructure will be needed. This includes personnel to attend the meetings and record the rationale, as well as to facilitate the process as needed.

(2) Computer/ Software Infrastructure. This thesis asserts that design rationale capture can be used to bridge managed care to the environment of

traditional medicine. That bridge is built in this infrastructure component of Davenport and Prusak's success factors. Other areas discussed, such as leadership involvement and providing facilitators, can be invoked in the existing system. However, no practical mechanism currently exists to link managed care to traditional medicine in the manner suggested. This infrastructure component is crucial to the success of rationale tools functioning as the bridge between managed care and traditional medicine.

Sufficient computer infrastructure is necessary within any organization to allow easy use of the software tools as well as access to the captured knowledge. Appropriate software, such as that used to capture process knowledge in the case study, and sufficient organizational infrastructure is required to build a knowledge culture within the organization.

3. Knowledge Orientation of Culture

a. Effect on the Development Team

There does not appear to be a central orientation to a knowledge culture in the hospital. There is not a consistent design for a pathway team deliverable, so the difficulty of dissemination is increased by the need for education on how each individual pathway works. Even though each pathway is for a specific disease process, there are similar components such as order sets, expected tests or procedures, etc. These could be organized in a hospital wide manner to increase familiarity and facilitate use of all the pathways. It would give the pathways a common look and feel.

In a similar fashion, there is no design to the pathway development process. Each team is left to their own devices to approach the problem. This may be by choice to stimulate variety, but there does not appear to be a mechanism for recording the pros and cons of various techniques used by each team. The default problem solving technique becomes the traditional waterfall method—identify a problem, collect data, formulate the solution, and implement the solution. Unfortunately this is inadequate in wicked problem resolution. The team could benefit from training on new problem solving techniques including argumentation-based techniques. This may decrease their frustration level and lead to more fruitful discussion. Simply learning that the problems they are trying to solve are not conventional problems may ease the frustration in itself.

One technique used by the team was to review several other clinical pathways for their design format. Unfortunately, there was no way for them to know why certain items were on the pathway and why others were not, or why the pages were formatted the way they were. They could only see the final result and formulate ideas for themselves or speculate on the design parameters. It is likely that the team could have become much more familiar with the development process for this disease had they been able to review the thoughts and ideas that went into the development of the example pathways. Preserving this process knowledge is the primary purpose of capturing design rationale.

b. Implications for Managed Care

A knowledge oriented culture is necessary to migrate toward a process-centric implementation of managed care policies. If physicians are to be able to review the thoughts and ideas that went into a practice policy development, then there needs to be a mechanism for them to do so. Specifically, a library of policies with associated captured process knowledge must be readily available, usable, and tractable. Each organization will need an ontology for their knowledge base so naming, filing, storage, and retrieval are predictable and easy to use.

Any team formulated to design a new policy can discuss pertinent issues and then search the knowledge base to review the manner in which other teams resolved the same issues. The past work may or may not be helpful, but the thoughts of previous workers are available as needed. As the knowledge base grows there will be fewer and fewer circumstances that have not been previously dealt with. Novel approaches will be formed, variations on previous approaches will be devised, and mistakes will be less likely to be repeated.

A mechanism must be in place to allow physicians to challenge the existing policies with new data or data that was not previously considered. There must be no barrier to this mechanism and organizational structure must be in place to determine when new policies will be developed or old ones revised.

When a team is formed to improve or change an existing policy, the assessment can be done by adding new issues, options, criteria for option selection, or any combination of the three. The thoughts and ideas of the previous design teams are not lost. Incremental change can occur and the knowledge of all the team members can be quickly "brought up to speed" without long oral histories or repeated literature searches.

4. Summary of Case Analysis

The development team did a remarkable job despite the inherent weaknesses in the system. The meetings were positive and their interaction was always congenial and non-contentious. It was clear that the team members desired to provide the best possible care for their patients and improve the level of care throughout the hospital for stroke patients. Unfortunately the pathway was not completed prior to the close of the data collection window for this thesis so the final product is not included. The rationale captured for the work done up to this point is shown in Appendix A.

The analysis touched only on weaknesses but this is only to show the benefit of design rationale as well as other elements of implementation that need to be considered. The team had several very good successes and breakthroughs in their process. Most notably, one member recognized the difficulty of physician buy-in in their environment. He recommended sending draft copies of the pathway to departments that will be involved for recommended changes and/or approval. This sort of management of planned change, that is likely to be successful, is something that could easily be incorporated into a development plan, should the hospital desire to create one.

The team demonstrated many of the problems encountered in the development and implementation of managed care policies. Their work and experiences are typical of many pathway development teams around the country in the author's experience. Although their work will undoubtedly be of the highest quality, evidence based, and incorporate sound medical judgment, they are set up for failure. Historically speaking, across the country and within their own institution, the chances of successful implementation of a clinical pathway are extremely low. The next section discusses a key reason for this failure and offers a new strategy for implementing managed care polices.

C. IMPLEMENTATION STRATEGIES AND CURRENT STATUS OF MANAGED CARE

The case analysis highlighted several points for improvement in the implementation of managed care policies. The theoretical analysis of organizational design in Chapter II suggests that design rationale capture can be used to bridge managed care to the environment of traditional medicine. Davenport and Prusak suggest several elements that may be put into place to enhance success in knowledge project. And experimental evidence from industry suggests that design rationale capture can be used successfully to improve the resolution of problems found in managed care. The ultimate question however, is how to implement the process.

The strategy for implementing change in an organization must assess and incorporate the distribution of power in its construct. This section first describes a power-based framework of strategies for coping with wicked problems and then describes medicine in terms of the framework. The default strategy in the current environment of managed care is described. And finally, a new plan for implementing managed care policies, incorporating design rationale capture, is offered.

1. Strategy Framework

Roberts recently proposed a framework of strategies for coping with wicked problems based on the power structure within an organization.[6] She describes three strategies based on the distribution of power and whether the power is contested. The strategies are Authoritative, Collaborative, and Competitive. Her descriptions are briefly summarized here.

a. Authoritative Strategy

Authoritative strategies are used when power is concentrated in one person or a small group of people. The authority has the power to define problems and implement solutions. The benefit of this strategy is it effectively tames the wicked problem since the authority defines the problem. The weakness of this strategy is the problem definitions and the chosen solutions may not always be what the stakeholders' desire.

b. Competitive Strategy

Competitive strategies are used when power is distributed and contested. This strategy is used for zero sum games where there are limited resources that stakeholders are competing over. In wicked problems the competition becomes one of power over problem definition and choice of resolution. The benefit of this strategy is it stimulates creativity and innovation. As a matter of survival, one stakeholder must come up with a technology, idea, or plan that is better than that of the opponent. The downfall however, lies in lengthy deadlocks, hurt relationships, or even war.

c. Collaborative Strategy

Collaborative strategies are used when power is distributed but not contested. It is used in a variable sum game where the sum may be greater than the parts. This is seen in corporate mergers, alliances and partnerships, government treaties, trade agreements, etc. The benefit of this strategy is the collective gain. Each of the collaborators achieves more than they could possibly achieve on their own. The weakness in this strategy lies in inertia. More stakeholders mean more people to convince of the correct path. The result is often a much slower process than an authoritarian strategy would exact, but with a much greater chance for communal agreement and gain.

2. Power Distribution in Medicine

In traditional medicine the autonomous physician holds all the power of medical decision-making. There are normative expectations and legal boundaries that are used as guidelines but the ultimate decisions lie solely with the physician. Traditional medicine does not require one of the coping strategies described above because it is a tame problem.

Managed care, in its effort to standardize care, imposes what may be considered an authoritative strategy onto traditional medicine. There are a wide variety of mechanisms used to try to standardize care including several types of practice policies, various approval processes, required documentation parameters, etc., but none have proven overtly successful. The reason for this failure is each is an attempt at applying an authoritative strategy to a system without centralized power.

In managed care, power is distributed. Physicians under managed care retain a great deal of power since they are ultimately making the medical decisions. However, any particular managed care plan exerts a degree of power over the physician through business rules. Administrators, business managers, and shareholders are stakeholders who each have a valid perspective in the decision making process. This bureaucratic layer effectively reduces the autonomy of the physician and spreads it across the managed care organization. There are many forms of managed care, but every form exerts some power over the physician. Power in managed care is distributed between the physicians and the bureaucracy of the particular managed care organization.

3. Physician Response

Historically, physicians have been very resistant to the power of the managed care organizations. The well-documented failure of the majority of clinical pathways exemplifies physician non-compliance with efforts to influence their practice patterns (Chapter I). It is not uncommon to find physicians learning necessary documentation techniques that will guarantee approval of the tests and procedures they desire. This practice circumvents an insurance plan's attempt at reducing costs and standardizing care. It suggests the strategy of managed care has defaulted to a competitive strategy.

The competitive strategy places the desires of the physicians against the policies of managed care. Physicians desire to practice in the manner they have been taught to be correct, and the managed care organizations desire to have standardized, cost effective care. The failure of managed care is due to the failure to accommodate the power distribution in policies. By trying to reduce physicians' power by reducing their autonomy, managed care becomes a system with distributed but contested power. The efforts of the managed care organization are pitted against the creativity of the physicians to get what they desire. The relationship may be congenial on the surface, but informal interviews with physicians suggest the deep undercurrents often involve physicians manipulating the system to practice in a manner they believe correct. And when policies are voluntary, they are only followed if they coincide with the existing practice patterns of the physician.

D. PROPOSED IMPLEMENTATION PLAN

The authoritative strategy of managed care has failed because of failure to accommodate the organizational power distribution in its construct. The result has been a default to a competitive strategy, which is currently failing. In the Roberts framework, collaboration is all that is left. Roberts believes that the desire to collaborate in most instances only grows from failure of all other alternatives. Specifically she states, "People and organizations fail into collaboration."[67] Managed care is at this point. A collaborative strategy is viable now that both the authoritative and competitive strategies have failed.

The manner in which the collaborative strategy is employed will depend on the organizational setting. In the military or a wholly owned managed care organization, the strategy can be deployed with an authoritative overlay, but in an open setting such as in the case study, it can only be deployed to encourage voluntary cooperation. The strategies are named, "Justify or Comply" and "Encouraged Participation."

1. Collaboration through Design Rationale Capture

Currently, when a practice policy such as a clinical pathway is written, the end result is distributed to the physicians. The thoughts and ideas that entered into the development of that policy are lost. The physicians have no way to know if their own practice patterns were considered in the process and what criteria or evidence was used to make the decisions. More importantly, there is little to no mechanism for input from the majority of physicians. Practice policies are developed by small groups or ad hoc committees and then imposed on the masses. When the policies are not in congruence with a physician's particular practice patterns there is likely to be frustration, non-compliance, and possibly anger.

---

[67] Office Conversation between Roberts NC and the author at Naval Postgraduate School, 26 Jul 00,

This is a common phenomenon in policy formulation. In many policy-making endeavors, input may be sought from several parties prior to a final policy formulation. However, not all parties are satisfied with the results and policy makers often end up justifying their decisions for countless hours after the fact.[68] The parties want to know that their ideas were considered and they want to know why they were not selected as the final choice.[69,70] Some may even feel betrayed if their ideas are not incorporated in the policy.[71]

In medicine, input is sought from many perspectives but through multidisciplinary teams rather than consensus across the disciplines. The constituency of each discipline's representation is often divergent on thoughts that should be incorporated into the policy so there is a high probability of disagreement with the policy after formulation. In managed care, physicians retain a great deal of power so rather than demand explanations they simply do not comply with the policies or circumvent them through system manipulation.

Providing physicians the mechanism of review and change is a way of returning autonomy to them and recognizing their power within the organization. The system is more in congruence with the existing culture and therefore will likely result in higher physician "buy-in" to the policies. Physicians will have the opportunity to see their practice patterns in side-by-side comparisons with those of others. This will allow the physicians to collaborate on policy formulation and possibly take the best components of all patterns to create new and better policies for all. It harnesses the brain trust of all physicians, rather than the few sitting on development teams behind closed doors.

---

[68] Gray B, *Collaborating- Finding Common Ground for Multiparty Problems,* pp.4, Jossey-Bass, Inc., 1989.

[69] Wondollek J, *The Importance of Process in Resolving Environmental Disputes,* Environ Impact Assess Rev, v.5, pp.341-356, 1985.

[70] Delbecq AL, *Contextual Variables Affecting Decision Making in Program Planning,* Journal of the American Institute for Decision Sciences, v.5, pp.726-742, 1974.

[71] Carpenter SL, Kennedy WJD, *Managing Public Disputes*, pp. 25, Josey-Bass, Inc., 1988.

Managed care has failed an authoritative and competitive strategy. It may be ready to implement a collaborative process, but collaboration is not free. It will take work and planning to implement a collaborative program that is unique to each organization. Elements from each of Davenport and Prusak's three main areas of emphasis must be addressed to facilitate success. Each organization needs to assess its culture and decide on the best implementation for them.

2. Justify or Comply

Justify or Comply is a collaborative strategy with an authoritative overlay. In this plan, design rationale capture can be used as the mechanism of collaboration but the final result is enforced through an agreed upon authoritative body.

The physicians and administrators must work together to establish the authoritative body and agreeable mechanisms for enforcement. When joining an organization using the Justify or Comply methodology, the physicians must agree to comply with the policies as written. The caveat is there must be a strong system in place to provide an opportunity for change through the collaborative mechanism described above.

In this situation, if a physician cannot justify a change to a practice policy through new data, or re-evaluation with ideas that were not previously considered, then there is no reason not to comply with the existing policy. If change can be justified then the policy can change and everyone is affected by the change. The physicians will have to justify any changes or comply with the policies.

This system will only work in a closed environment where the physicians are salaried employees or within a single insurance plan. A hospital such as that in the case study is subject to too many different plans to make the justify or comply methodology work within their setting.

3. Encouraged Participation

Encouraged Participation is a purely collaborative implementation. It is Justify or Comply without the authoritative overlay. Design rationale capture is used as a collaborative mechanism in the existing structure of managed care. Without the authoritative overlay the degree of standardization achieved will likely be less than that in the Justify or Comply implementation but much better than that from the existing competitive environment.

The senior leadership support and the development of a knowledge culture become the limiting factors to success. This strategy may indeed create a better environment for medicine than Justify or Comply because it will stimulate the creativity of the administration in an effort to avoid returning to the current competitive environment.

E. CONCLUSIONS

The case study in Chapter V exemplified the misfit of managed care to the environment of traditional medicine and demonstrated several areas where the techniques of design rationale capture could aid in the process of medical policy development. Most importantly, the case highlighted the need to accommodate the distributed power structure of organized medicine. A new strategy for implementing managed care is offered using design rationale capture as a mechanism of creating a collaborative environment for design. Two methods of implementing the collaborative strategy are given based on the organizational structure of the organization.

VII. SUMMARY, FUTURE RESEARCH, AND CONCLUSION

A. SUMMARY

This thesis is written under the premise that managed care is failing, and that the American people desire the care provided in traditional medicine at the prices of managed care. The hypothesis is made that managed care is failing because the problems encountered in managed care are fundamentally different than those encountered in traditional medicine and the organizational design of managed care is not set up to handle the problems it generates. Design rationale capture is offered as a mechanism to bridge the business concepts of managed care to the ideology of traditional medicine. A collaborative strategy for implementing managed care is recommended using design rationale capture as the mechanism of achieving collaboration.

Chapter II examines the type of problems encountered in managed care and the organizational design of managed care. The problems and organizational design are compared to those of traditional medicine in an effort to assess reasons for the failure of managed care. The assessment demonstrates that managed care deals in wicked problems, while traditional medicine deals in tame problems. The difference stems from the level of focus. Traditional medicine focuses on the individual while managed care focuses on the population. Unless tamed by other means, the wicked problems of managed care require collaboration to solve them. Rittel called this an "argumentative process," designed to stimulate the expertise of many people. By argumentative he meant raising issues that are dealt with, which in turn raise new issues that must be considered; a process that continues indefinitely, in an open-ended format.

The recognition that managed care deals in wicked problems leads to the need for a collaborative effort to handle the problems. However, there is no mechanism in managed care to facilitate widespread collaboration. The mechanism of policy development through small multi-disciplinary teams has failed in this regard. This thesis offers the capture of process knowledge as a mechanism of facilitating widespread collaboration in the development and maintenance of managed care medical practice policies. Specifically, argumentation based design rationale capture methods are recommended over documentation or communication based methods because of their advantage in usability, expressiveness, and tractability. Chapter III provides background information in these and other knowledge management issues, and Chapter IV provides theory underlying argumentation based design rationale capture tools.

Chapter V looks into the necessary elements for implementing these tools in the managed care environment. Specifically, examination of successful knowledge projects in industry and review of experimentation in the type of problems and projects likely to have successful utilization is made. Common elements from successful projects are used to provide insight to implementation objectives. Experiments in software engineering suggest managed care problems possess many of the elements that lead to successful utilization of these tools. And lessons from a variety of knowledge projects suggest senior leadership must be targeted for marketing their support, adequate infrastructure, and the development of a knowledge culture. A case study from a small community hospital is used to exemplify several of the principles.

The appropriateness of a collaborative effort in the environment of managed care is investigated in Chapter VI. Rittel suggests collaboration is needed in wicked problem resolution, but a collaborative plan must fit the organizational culture. A framework of strategies for dealing with wicked problems, based on power relationships in an organization, was used in this assessment. The assessment revealed that managed care currently utilizes an authoritative strategy to implement practice policies. However, due to the cultural misfit of this strategy, specifically with respect to the distributed nature of power in the organization, the strategy has defaulted to one of competition. The managed care organizations' desire to modify the practice patterns of physicians is pitted against the creativity and autonomy of physicians. The result is generalized frustration and system failure. The assessment suggests that a collaborative strategy is most appropriate for the distributed nature of power in managed care, if the fit to traditional medical practice is to be maximized.

Also in Chapter VI is the analysis of the case study from Chapter V. The case is analyzed as a knowledge project. The analysis provides insight into system wide changes that are needed to implement a collaborative strategy; specifically, with respect to high-level management support, adequate organizational and computer/software infrastructure, and a culture conducive to knowledge projects. The assessment shows where design rationale tools fit in the overall implementation plan and suggests that it will take considerable work on the part of any organization to implement.

A collaborative strategy can be implemented but only with the placement of a strong mechanism to involve the entire physician brain trust in decision-making. Argumentation based design rationale capture can be used to preserve corporate memory and allow iterative changes to existing policies. Specifically, the rationale behind decisions can be maintained such that physicians can see if their particular practice patterns were considered in a policy formulation, and if so, why it was or was not chosen as the policy. If new data is found or certain options were not previously considered then the decisions can be revised without starting over. Changes can be made iteratively and the process knowledge gained in previous decision efforts is not lost to the frailty of human memory.

The physical implementation of such a mechanism will take strong support from senior leadership including funding for infrastructure, dedicated knowledge workers, and adequate software. It also takes commitment on the part of all participants to follow the implementation plan. Two implementation strategies are described depending on the design of the organization. First, for closed systems, the collaborative strategy utilizing design rationale capture as a mechanism of involving physicians in decision making can be used but an authoritative overlay can be implemented. This is known as "Justify or Comply." In an open system, the same implementation without the authoritative overlay is used. This is known as "Encouraged Participation."

B. FUTURE RESEARCH

This thesis assesses the feasibility of using argumentation based design rationale capture as a mechanism of bridging the principles of managed care to the environment of traditional medicine. It recommends using this mechanism to aid in a collaborative strategy for managed care policy development and implementation. As a theoretical work the thesis leads to many research questions. Several of these questions are discussed here.

1. Software Tools

Presently there are only two commercially available general-purpose design rationale capture software tools. Continued research is needed into meaningful representations and diagramming techniques, including specific specialized needs for medical applications.

The existing tools could be modified to increase their decision support capability in medical use. For example, if a complete rationale tree is developed for the diagnosis or treatment of a specific disease, a user could be prompted to fill in patient specific values. The program would then automatically select options by comparing the patient values to formulas in the criteria built into the tree. This in effect would act as an expert system, but with the rule sets easily seen for educational purposes, and for review or modification as needed.

Neither of the commercially available tools is currently web-enabled. In medical applications, the widest dissemination possible is needed. The most ubiquitous access currently is the Internet. Development of web-enabled versions of design rationale software would markedly enhance the usability of the tools.

2. Leadership Support

The effect of leadership support on medical practice policy implementation needs evaluation. It is well known that a passive effort with voluntary participation is not successful. How much support is sufficient is a reasonable question to ask. Leaders may desire to titrate their efforts to effect, however, if they believe the policy implementation is important then they will need to demonstrate that belief in action.

Leadership will desire to know the value of the knowledge captured prior to committing resources to a knowledge project. Experimentation is needed, possibly through surveys of physicians, on the utility and usability of the captured process knowledge. Business case evaluations are also needed for knowledge projects in the managed care environment.

3. Organizational and Computational Infrastructure

Personnel are needed to support the knowledge culture. How many people and in what positions needs to be determined. Functions of education and training, librarianship, and maintenance are needed. Personnel to capture knowledge in meetings, and possibly an ontologist will be needed as well. The personnel requirements and optimal management structure for each of these within an organization is required. Mechanisms and policies are needed to allow physicians the opportunity to review and recommend change to existing policies, or to develop new policies.

Research is needed to determine the adequate background training in knowledge management necessary to effect a successful knowledge management program. The argumentation-based techniques may reduce the need for trained group facilitators. The cross over point between the need for a facilitator and the ability of the techniques to facilitate must be investigated.

The need for physical infrastructure will be determined by the software and the required level of access. The physical architecture and lifecycle management of hardware and software will be fiscally determined. Little research is needed in this area since it is mainly a business decision.

4. Knowledge Oriented Culture

Experimentation is needed on various aspects of the knowledge-oriented culture. This area is so new that any implementation of any knowledge project in managed care will be an experiment in itself. These cultures should be studied to seek out successful aspects in medical applications. The effect on the culture from various infrastructure and senior leadership changes can be measured to find the most effective method within the organization.

Trials of active design rationale capture in policy development teams are needed. That is, capturing the rationale when the team is using the methodology as opposed to passively capturing process knowledge as the team interacts as was done in the case study. Differences in the process as experienced by the team and differences in the captured process knowledge can be measured to work toward an optimum technique.

C. CONCLUSION

The conclusion drawn from this thesis is that argumentation based design rationale capture is an outstanding candidate for the mechanism to bridge managed care to the environment of traditional medicine. The techniques are specifically designed for aiding in the resolution of wicked problems, the problem type encountered in managed care. Managed care possesses many of the characteristics that have been experimentally shown to correlate with successful utilization of the argumentation-based software tools. And the power relationships in the environment of managed care are consistent with a collaborative strategy of policy implementation. However, the techniques and tools alone will not solve the problems of managed care. Senior leadership support is needed along with adequate organizational and computer infrastructure, and a knowledge oriented culture. Further research is needed in all of these areas to prove this theoretically demonstrated feasibility.

THIS PAGE INTENTIONALLY LEFT BLANK

APPENDIX A CASE STUDY RATIONALE

This appendix contains the rationale captured during the development of a critical pathway at a community hospital. The pathway was for the care of the stroke patient. The pathway was not completed prior to closure of the data collection time window for this thesis. The rationale shown documents the process completed up to that point.

The rationale were captured passively. That is, the team did not follow an argumentation based problem exploration process. The rationale therefore is documented in diagrams and text rather than specific evaluated criteria. In the decision about which stroke scale to use, specific criteria were obtained from the rehabilitation services member of the team for inclusion in this report.

The software tool used in this capture project is based on the QOC methodology. It displays questions (called issues in this software product) and options on one screen, and criteria in a spreadsheet format on another screen. A sample diagram documenting a question with three options is shown in Figure 10. The check mark on Option 1 denotes it was selected as the option of choice. The red X on option 3 suggests it was specifically rejected. And no markings indicate the option is left as proposed; not specifically chosen or rejected.

Figure 11 shows the rationale table associated with the diagram in figure 10. It displays three criteria for evaluating the options and the assessment of the options per each criterion. This particular tool allows for qualitative or quantitative evaluations. If quantitative values are used then a score and ranking can be automatically calculated for comparison, based on user-entered formulae. In the case study, the rationale table was only used for the decision involving choice of stroke scale, as noted above.

The tool is a hyper-linked XML document. “Clicking” on any of the diagram nodes brings up a dialog box where notes can be recorded. The rationale table can also

be brought up with a mouse click. The documentation in this appendix is a transcription of what is found in the respective dialog boxes for each of the nodes.

The overall diagram for the captured rationale is shown in Figure 12. It is unreadable and therefore is broken into 6 sections as shown in Figure 13. The appendix is organized into six sections corresponding to the six boxes, A through F, shown in Figure 13. Each section depicts an expanded view of its respective diagram and lists the associated rationale that was recorded.

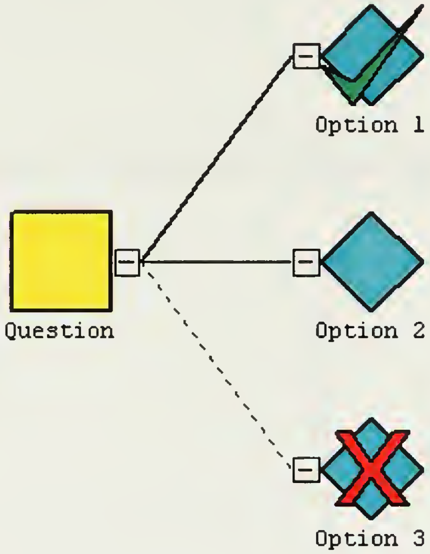
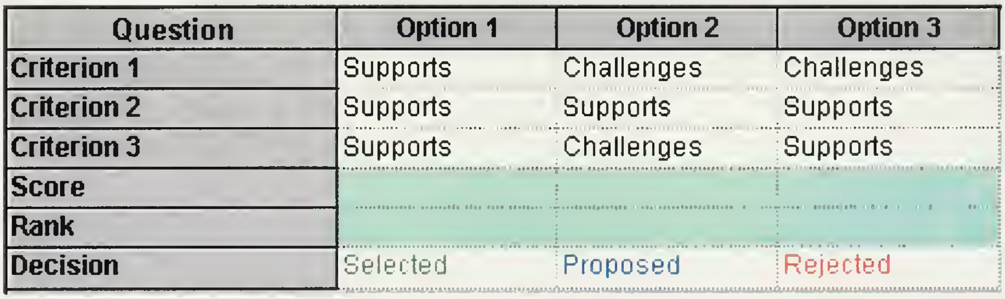


Figure 10: A sample rationale diagram from the software used in the case study



Question	Option 1	Option 2	Option 3
Criterion 1	Supports	Challenges	Challenges
Criterion 2	Supports	Supports	Supports
Criterion 3	Supports	Challenges	Supports
Score			
Rank			
Decision	Selected	Proposed	Rejected

Figure 11: Criteria Associated with Sample Diagram in Figure 10

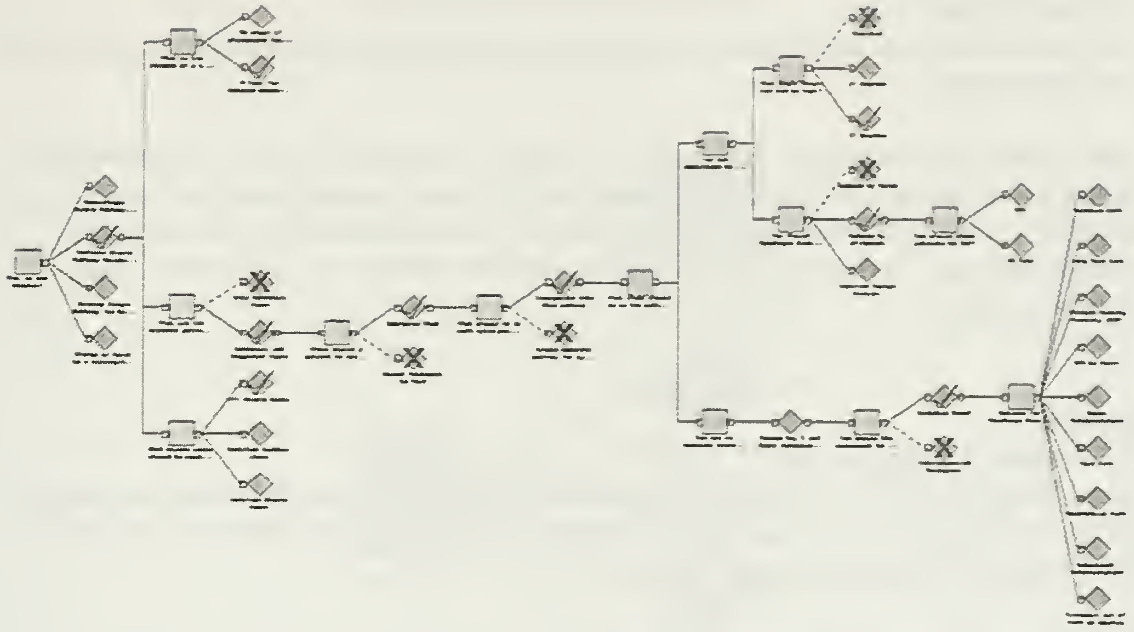


Figure 12: Complete Case Study Diagram

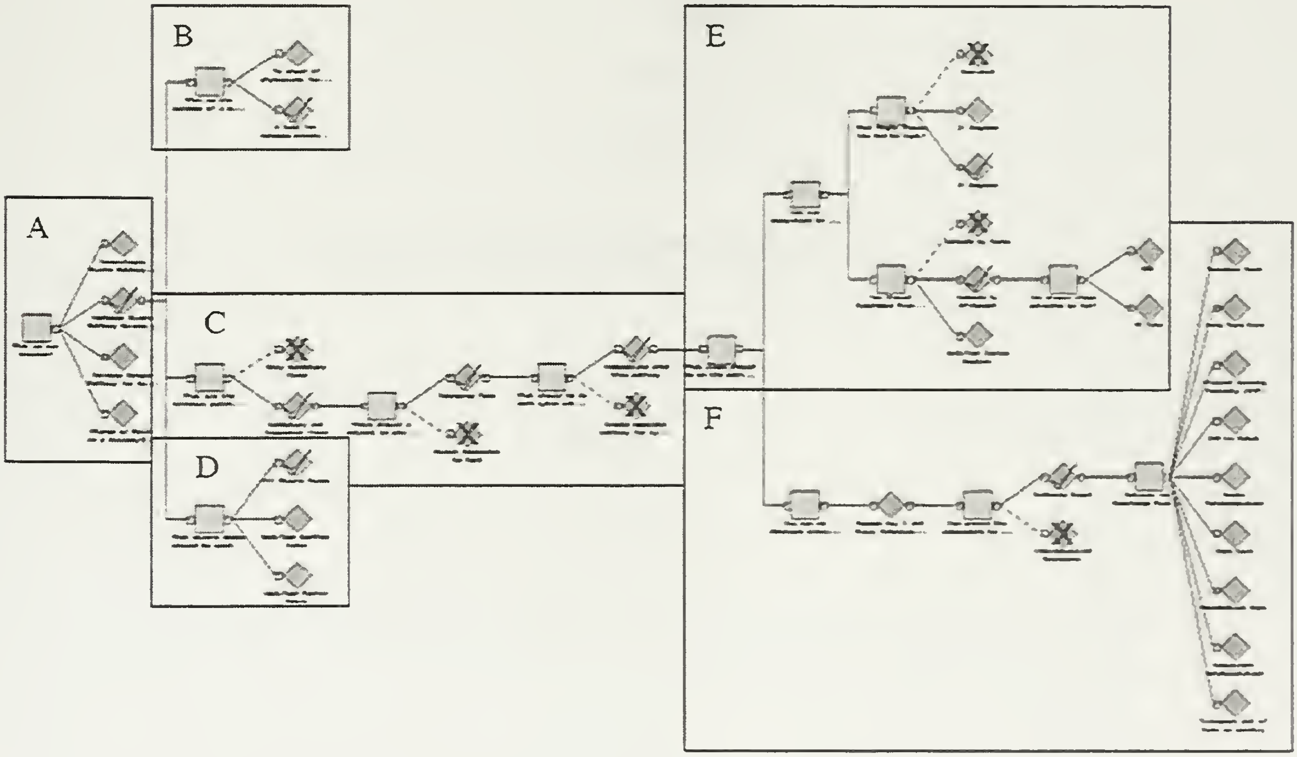


Figure 13: Segmented Diagram from Case Study

Project Notes:

The hospital has convened a team to develop a critical pathway for care and treatment of the stroke patient.

The team is multidiscplinary. It is co-led by an ICU nurse manager and a Neurologist. Members include an ER doctor, 2 Internists, an ER nurse, a nurse from the main pavaillion, and representatives from home health, rehab services (physical therapy), cardiopulmonary services, nutrition services, patient relations, hospice house, and medical records.

Goals:

1) Minimize Length of Stay

Target length of stay is 4.7 days based on reimbursement. The length of stay is a major portion of hospital costs. There may be significant wasted time waiting for orders to be acted on and results interpreted.

2) Maximize Quality of Care

Patient care quality is the ultimate goal. Cost is secondary to providing good care but is something that needs to be considered.

RATIONALE SECTION A

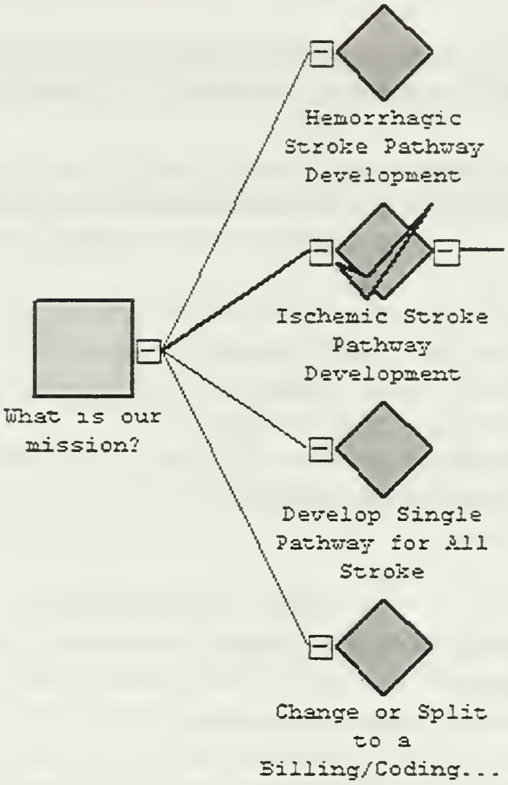

Hemorrhagic Stroke Pathway Development
Ischemic Stroke Pathway Development
What is our mission?
Develop Single Pathway for All Stroke
Change or Split to a Billing/Coding...

Figure 14: Rationale Diagram Section A

Issue: What is our mission?

Stroke can be grossly divided into hemorrhagic and ischemic stroke. The treatment for each is very different so it should be decided which is the focus of the team.

5/23/00

Although we want this to be research based there is not complete understanding and consensus on treatments. At minimum it will be literature based.

The ultimate goal of the pathway is to provide quality care to the patients. The notion of the cost savings is important and must be considerd but us not to compromise good medical care.

13 Jun 00

Opportunity Statement requestd by QA office.

Development of the stroke clinical pathway at XXX Hospital provides an opportunity to:

- improve functional outcome of stroke patients
- improve patient quality of life
- improve quality and consistency of care
- improve efficiency of care
- reduce lengh of stay
- reduce cost
- clarify patient expectations of stroke care and outcomes
- improve patient education
- improve and optimize rehabilitation potential
- improve knowledge and practice patterns of health care providers
- improve patient, physician, and staff satisfaction with stroke patient management

Option: Hemorrhagic Stroke Pathway Development

The volume of hemorrhagic strokes is much less than ischemic strokes but the financial losses appear much more significant.

If hemorrhagic stroke is included we should include a neurosurgeon in the pathway development team.

These patients have higher comorbidities, etc and often need a much longer pathway. It would be difficult to keep both type patients on one pathway.

Option (SELECTED): Ischemic Stroke Pathway Development

The volume of ischemic strokes is much more than hemorrhagic strokes but the financial losses appear much less significant.

The suggestion is made to make an ischemic pathway only and then revisit the issue of including hemorrhagic patients after the ischemic pathway is developed. At that point the meaning of including these patients on the same pathway will be understood. At this point, prior to the pathway development it is difficult to say how the differences in these patient types will affect the pathway.

The group agrees and the pathway will be for ischemic strokes.

Option: Develop Single Pathway for All Stroke
Stanford and other hospitals have a single pathway. It is not unreasonable to have a single pathway.

"Stroke is stroke" but there is a divergence in care between ischemic and hemorrhagic strokes. It may overwhelm the pathway to try to include both.

For optimizing care, improving rehab, etc, the two are very similar but the actual in house care is very different. The hemorrhagic patients are likely to fall off the pathway quite often.

A question arises if there is benefit for keeping hemorrhagic patients on the pathway until they drop off for whatever reason. That is, is there benefit to the patients to stay on the general pathway for the first few days?

Option: Change or Split to a Billing/Coding Team
The coding is so complicated that two side by side patients may be reimbursed at significantly different levels simply because of the way they are coded. The coding is based on the charting and discharge summaries.

RATIONALE SECTION B

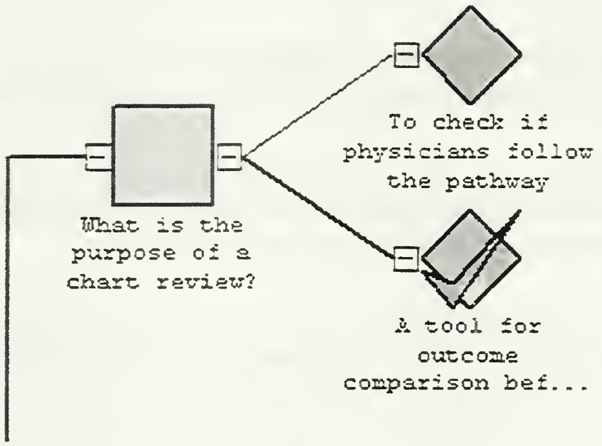

What is the purpose of a chart review?
To check if physicians follow the pathway
A tool for outcome comparison bef...

Figure 15: Rationale Diagram Section B

Issue: What is the purpose of the chart review?

A chart revew will be used to better understand the medical variation in stroke patient care and confounding variables such as morbidity compared to onset of symptoms and initiation of care.

50 random stroke charts will be pulled from medical records and reviewed by one physician using a checklist developed by the pathway development team.

Option: To check if physicians follow the pathway
The chart review could be used for this in the future but this is not the basic premise behind the review.

Option (SELECTED): A tool for outcome comparison before and after pathway implementation
The idea of the chart review is to see where the variances in care exist and how the pathway changes those variances.

This purpose determines the focus of the chart review and the content on the review.

Items such as vital signs are moot since they will be done on everyone. Items such as mode of arrival (ambulance vs famil member/POV) could be helpful for community outreach/education if a large variance in morbidity is shown between the two.

RATIONALE SECTION C

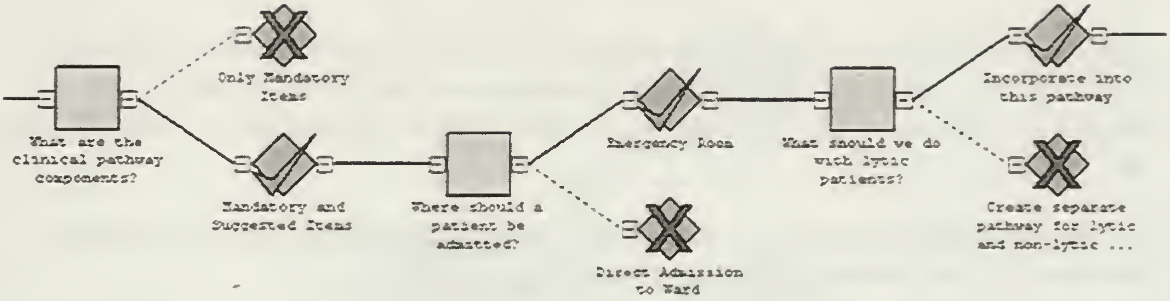

What are the clinical pathway components?
Only Mandatory Items
Mandatory and Suggested Items
Where should a patient be admitted?
Emergency Room
Direct Admission to Ward
What should we do with lytic patients?
Incorporate into this pathway
Create separate pathway for lytic and non-lytic ...

Figure 16: Rationale Diagram Section C

Issue: What are the clinical pathway components?

The pathway will be divided into days of admission. It will start in a preadmit/ER day and then move to Day 1 which would begin when the patient arrives on the ward.

The question arises of what to include as far as mandatory only or suggested items as well.

Option: Only Mandatory Items

This is an educational tool as well so adding suggested items will be added.

Option (SELECTED): Mandatory and Suggested Items

Including suggested items for orders on the pathway provides an educatonal aspect to the pathway and is helpful for quality of care with respect to not forgetting a long list of items in an emergency situation.

Not all possible or suggested items can be listed but common ones that the team thinks of will be added. This can be modified as the pathway develops.

Issue: Where should a patient be admitted?

Some patients historically are direct admitted to the ward and bypass the ER.

Option (SELECTED): Emergency Room

Stroke is an emergency diagnosis. The emergency room has priority in the CT scanner and to other diagnostic/treatment modalities. If the patient goes directly to the ward there may be lost evaluation opportunities.

Especially any patient with potential for lytic therapy needs to go to the Emergency Room.

Many of these patients are not clearly labeled as "Stroke" patients. They often have a wide variety of symptoms and confounding variables such as previous cancer with concern for metastasis, EtOH withdrawal, etc. that requires emergency evaluation to sort out.

The process of admitting all neurologic deficit patients through the ER will take some education for the community EMS and hospital personnel.

Option: Direct Admission to the Ward
Some patients may be so far out in time or have other criteria that they are clearly not lytic therapy candidates, or are not emergency patients.
There may be some patients that can go directly to the ward but anyone with new onset stroke should go to the ER.

Anyone going directly to the ward will probably not be on this pathway.
A decision will have to be made in these cases but it is recommended that all stroke patients go to the ER unless overridden by their admitting physician.

If the patient goes directly to the ward then they probably will not be on the pathway.

Issue: What should we do with lytic patients?

Some of the orders change with lytic therapy. Do we need a separate pathway for lytic and non-lytic patients?

Option (SELECTED): Incorporate into this pathway
Both lytic and non-lytic ischemis stroke patients will be included in this pathway. Many of the orders are the same for both. If an order is changed such as for indication of foley or NG tube, or for certain medications then the order sheet can be split. One half of the page can be for patients who have had lytic therapy and the other half for those who have not or something of the sort.

Option: Create separate pathway for lytic and non-lytic patients
If we separate the pathways then it will be confusing for staff on which paperwork packet to use and will also start creating small groups for care. This is not in congruence with simplifying the process. It will be possible to incorporate both categories on one pathway.

RATIONALE SECTION D

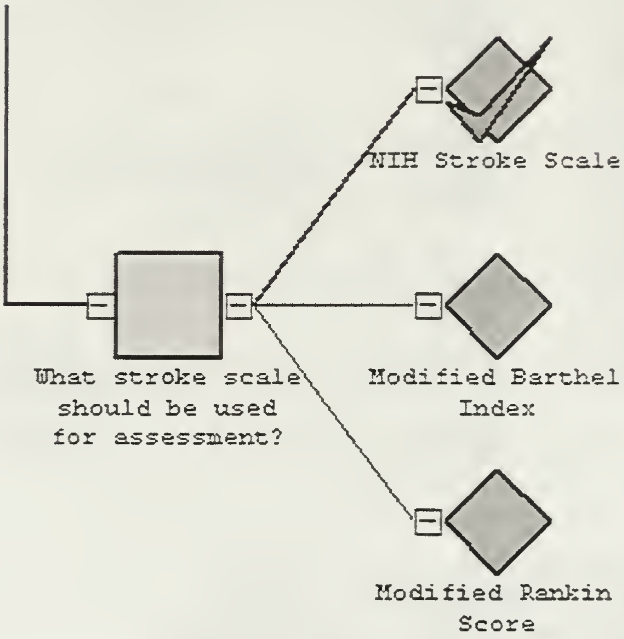


Figure 17: Rationale Diagram Section D

Issue: What stroke scale should be used for assessment?

A stroke scale may be helpful in determining progression of symptoms and quantitative measure of morbidity.

Option (SELECTED): NIH Stroke Scale
Option: Modified Barthel Index
Option: Modified Rankin Score

What stroke scale should be used for assessment?	NIH Stroke Scale	Modified Barthel Index	Modified Rankin Score
Time to Administer	10 Minutes	<40 Minutes	<1 Minute
Validity	High	High	Moderate
Reliability	High	High	Moderate (Subjective)
Who can administer?	Trained Non-Physician	Non-Physicians	Physicians
Can be done in acute care?	Yes	No	Yes
Statistical/ Historical Use?	Yes	No	No
Decision	Selected	Proposed	Proposed

Table 4: Rationale Table for Stroke Scale Decision

Specific Notes on Criteria:

Criterion: Can be done in Acute Care?

MBI -Requires observaton of activities of daily living.
-May be appropriate for outcome studies if performed by rehab professionals.

Criterion: Statistical/Historical Use?

NIH -Used in many t-PA studies.
-Wide domain covered.
-Interval scale.

MBI -Ordinal Scale: not easily statistically evaluated

Rankin -Not used much in studies.
-No consensus about cut offs, for example, "What constitutes a bad outcome."

RATIONALE SECTION E

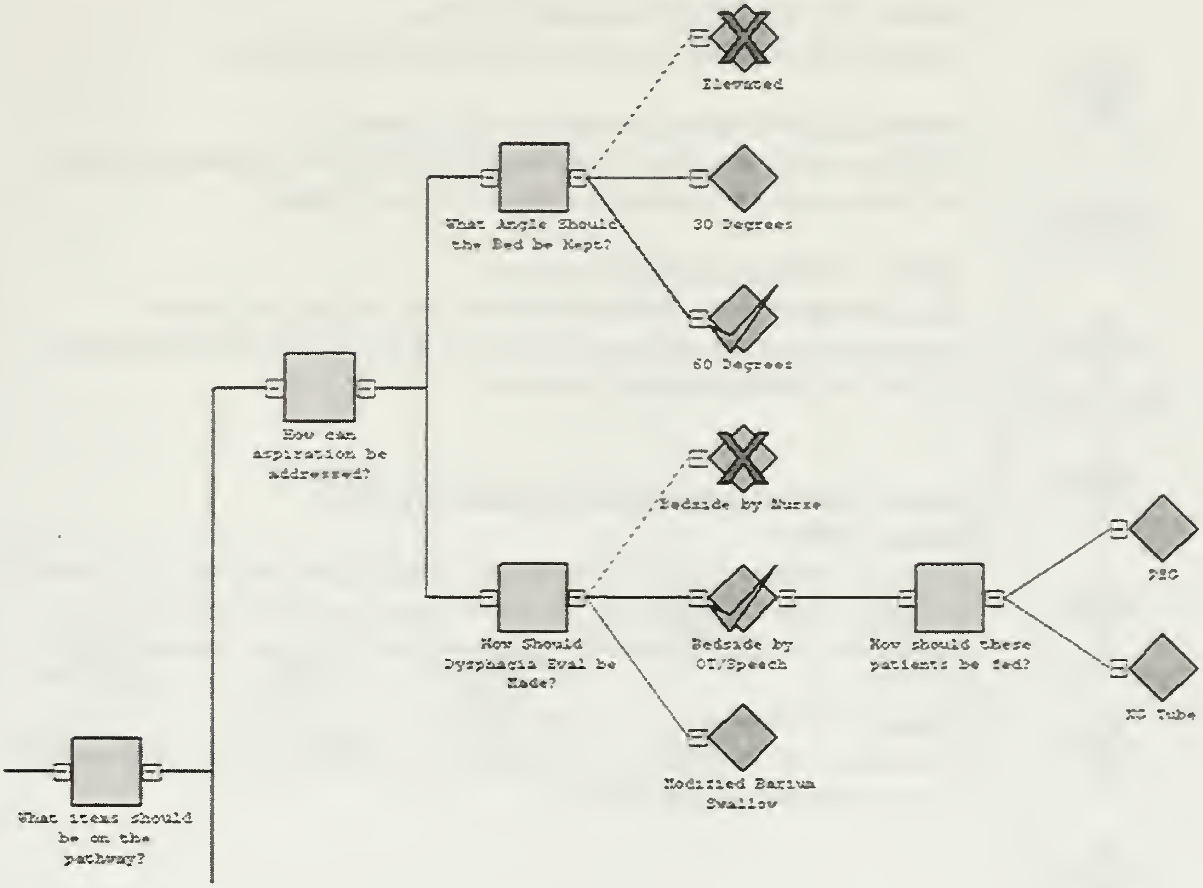

Elevated
30 Degrees
What Angle Should the Bed be Kept?
60 Degrees
How can aspiration be addressed?
Bedside by Nurse
PEG
How Should Dysphagia Eval be Made?
Bedside by OT/Speech
How should these patients be fed?
NG Tube
Modified Barium Swallow
What items should be on the pathway?

Figure 18: Rationale Diagram Section E

Issue: What items should be on the pathway?

Issue: How can aspiration be addressed?

Issue: What angle should the bed be kept?

Option (REJECTED): Elevated

This order is unsatisfactory. It leaves too much room for error.

Option: 30 Degrees

This is usually inadequate in stroke patients, especially if they have a large belly, or risk of emesis.

Option (SELECTED): 60 Degrees

This is the safest recommendation by rehabilitation services. All stroke patients should keep head of bed at 60 degrees for aspiration risk.

Issue: How should dysphagia eval be made?

Option (REJECTED): Bedside by Nurse

Nurses are not trained adequately to perform this evaluation.

Option (SELECTED): Bedside by OT/Speech

OT/ Speech has very good experience in this hospital. Historically there has been no need for barium swallows on every patient.

Option: Modified Barium Swallow

Not a necessary in this hospital because of experience in bedside evaluations by rehab services. This is left as an option for cases that are difficult for the experienced evaluators.

Issue: How should these patients be fed?

Option: PEG

Need to determine a cut off for placing a PEG. Some feel the PEG should be placed if the NG tube is in for 1 week or more while others say for 2 weeks or more. This is something that will not be solved immediately.

Option: NG Tube

These tubes can be irritating to the upper aero-digestive tract and can lead to complications such as sinusitis.

RATIONALE SECTION F

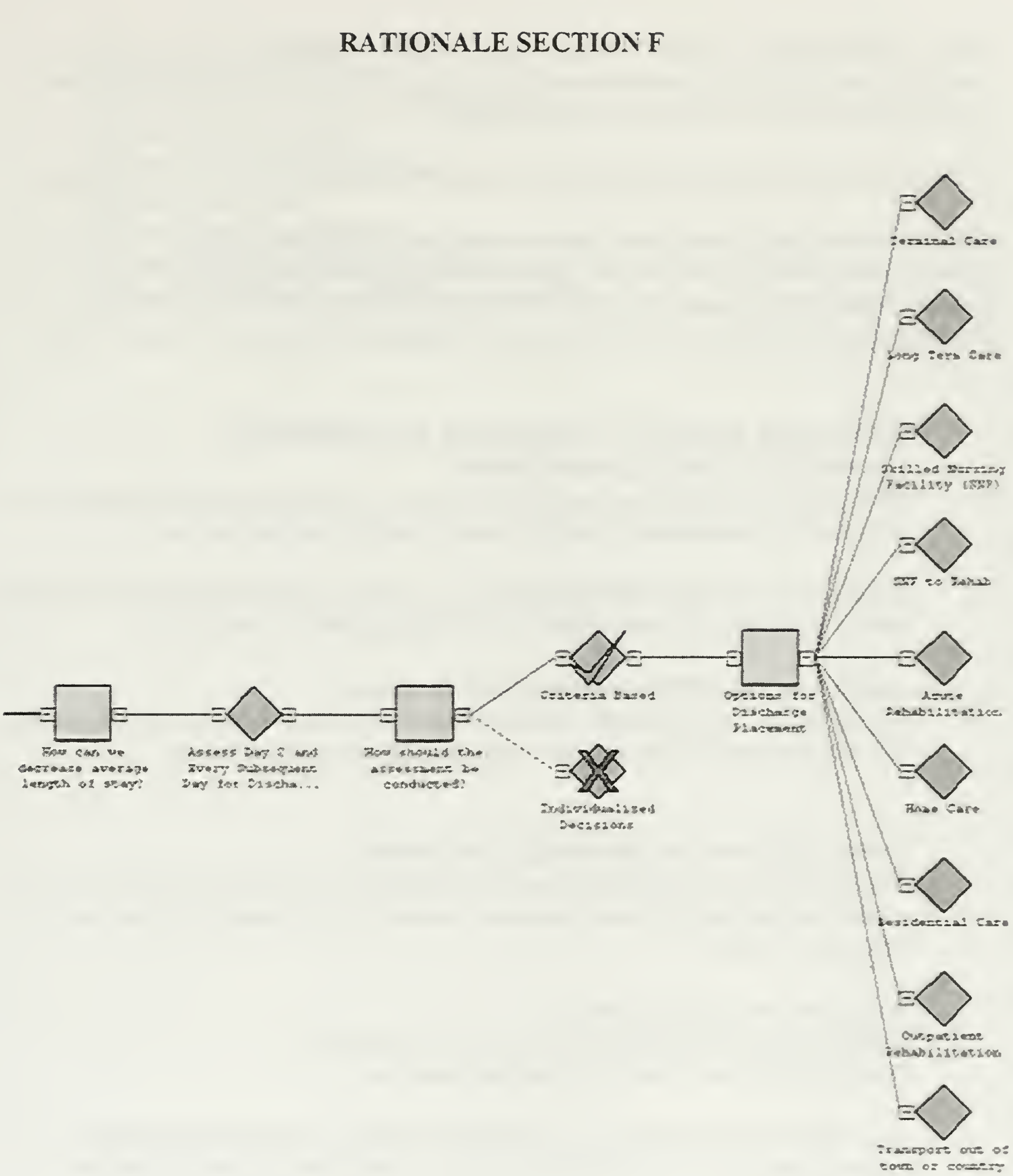

Terminal Care
Long Term Care
Skilled Nursing Facility (SNF)
SNF to Rehab
Criteria Based
Options for Discharge Placement
Acute Rehabilitation
How can we decrease average length of stay?
Assess Day 2 and Every Subsequent Day for Discha...
How should the assessment be conducted?
Individualized Decisions
Home Care
Residential Care
Outpatient Rehabilitation
Transport out of town or country

Figure 19: Rationale Diagram Section F

Issue: How can we decrease average length of stay?

Length of stay is highly variable between physicians. The chart review is not complete but is hopeful to show differences in patient care.

In the mean time there are ideas that can be added to the pathway to aid in discharge.

Option: Assess Day 2 and Every Subsequent Day for Discharge status

At day 2 many patients will "declare" themselves. There are basically three levels of patients: those that will need long term care or rehab facility, those who can be discharged home, and then those that will need longer assessment or in hospital care.

Issue: How should the assessment be conducted?

Option (SELECTED): Criteria Based

Criteria give a standardized approach of items to check prior to discharge such as prior level of functioning, point of contact, support mechanism, etc.

Some issues are clearly needed on the list but others such as driving status are not clearly delineated for responsibility. All will be added on the pathway.

Option (REJECTED): Individualized Decisions

A non-standardized approach will lead to marked variety in discharge parameters that are checked. This leaves too much room for missed parameters.

Issue: Options for Discharge Placement

The choice for d/c placement is very complicated. It is based on prognosis, level of care needed, and financial situation. Location for discharge will determine if transport is needed.

Physicians determine prognosis.
Rehabilitation Services determines level of care needed.
Discharge Planners determine financial situation.

The rules for each of the options are quite complex. The discharge planner is the expert in the law and will be utilized to list criteria for the three areas on the pathway sheets.

Criteria for choosing options:
Prognosis
Finances
Skilled Nursing Need?
Location for Discharge

Option: Terminal Care
Option: Long Term Care
Option: Skilled Nursing Facility (SNF)
Option: SNF to Rehab
Option: Acute Rehabilitation
Option: Home Care
Option: Residential Care
Option: Outpatient Rehabilitation
Option: Transport out of town or country

THIS PAGE INTENTIONALLY LEFT BLANK

INITIAL DISTRIBUTION LIST

1. Defense Technical Information Center 2
8725 John J. Kingman Road, Ste 0944
Fort Belvoir, VA 22060-6218

2. Dudley Knox Library 2
Naval Postgraduate School
411 Dyer Road
Monterey, CA 93943-5101

3. Dean Dan C. Boger, Code IW 1
Naval Postgraduate School
Monterey, CA 93943-5118

4. Professor Kishore Sengupta, Code SM/Se 1
Naval Postgraduate School
Monterey, CA 93943-5118

5. Professor Daniel R. Dolk, Code SM/Dk 1
Naval Postgraduate School
Monterey, CA 93943-5118

6. Professor Nancy Roberts, Code SM/Rc 1
Naval Postgraduate School
Monterey, CA 93943-5118

7. Professor Erik Jansen, Code SM/Ek 1
Naval Postgraduate School
Monterey, CA 93943-5118

8. CDR Daniel J. Zinder, MC USN 2
6228 22nd Street
N. Arlington, VA 22205

9. RADM B.B. Potter, MC USN 1
CINCLANTFLT Surgeon
Commander in Chief, US Atlantic Fleet
1562 Mitscher Ave., Suite 250
Norfolk, VA 23551-2487

10. G. Richard Holt, MD, MPH 1
Executive Vice President
American Academy of Otolaryngology- Head and Neck Surgery
One Prince Street
Alexandria, VA 22314-3357

11. CAPT Greg Parker, MC USN 1
Commanding Officer
Naval Hospital Bremerton
HP01 Boone Road
Bremerton, WA 98312

12. David A. Zinder, PE 1
4121 W. Augusta
Phoenix, AZ 85051

13. Steven M. Zinder, PhD Code 2B 1
University of Virginia - Sports Medicine
186 Landon Lane
Orange, VA 22960

14. William R. Johns, PhD 1
Crayside, Whitechurch Road
Crays Pond, Reading RG8 7QA
United Kingdom

15. Martin Lipp, MD 1
Cypress Health Networks
787 Munras Avenue, Suite C
PO Box 1151
Monterey, CA 93942

32 473NPG 542
11/02 TH 22527-200 NLB

DUDLEY KNOX LIBRARY
3 2768 00404646 6